NOTES ON THE TYPE OF HESPEROPITHECUS HAROLDCOOKII OSBORN[1]

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Through the courtesy of Professor Osborn, who has recently described[2] the type of *Hesperopithecus haroldcookii*, we have had the opportunity of making further studies upon this already famous specimen, the results of which are submitted below.

I. ANALYSIS OF CHARACTERS OF THE TYPE

A careful consideration of the characters afforded by the badly eroded and worn type upper molar leads us to distribute them under the following categories.

I. *Characters due to long exposure to weathering, erosion, and stream or wind action*
   (a) Extreme rounding of all angles, margins, ridges, and projections of crown and roots
   (b) Breaking off of postero-external (disto-buccal) root and smoothing of site of root

[1] The plates used in the illustration of this paper were originally prepared for the *American Museum Novitates* (see foot-note 2), and have been loaned to the *Journal of Dental Research*.

[2] Osborn, Henry Fairfield, 1922. *Hesperopithecus*, the first anthropoid primate found in America. *American Museum Novitates*, no. 37; 5 pp., 3 figs. (Reprinted without figures in *Science*, vol. 55, pp. 463–465; May 3, 1922.)

(c) Loss of enamel on entire external surface and half of posterior surface

(d) Presence of numerous large and small cracks and fissures, and rounding of the margins of the cracks, causing the cracks to simulate the appearance of the natural fissures between cusps

II. *Characters due to extreme natural wear of the crown*

(a) Extreme shortness or apparent brachyodonty of crown, and loss of all main cusps

(b) Close apparent approximation of hypocone to protocone

(c) Evenly concave wearing surface

(d) Deposition of secondary dentine on roof of pulp cavity, beneath wearing surface.

(e) Diminished size of root canals.

III. *Chief diagnostic characters of Hesperopithecus type*

(a) Upper molar crown conforming to the general type that is common to the anthropoids and man

(b) Evenly concave masticating surface, as in *Pithecanthropus*

(c) Very large divergent roots, a primitive character retained in the gorilla and in *Pithecanthropus* and, to a less extent, in certain human teeth

(d) Transverse diameter of antero-external root smaller than in human molars

(e) Floor of pulp-cavity well raised above bifurcation of roots, as in man (*fig. 5*)

(f) Form of floor of pulp-cavity resembling that of anthropoids and man

II. REMARKS ON FIGURES 1–4

Fig. 1. The crown of the *Hesperopithecus* molar was worn down by use nearly to the base, so that the cusps had entirely disappeared. After death the tooth was badly cracked, battered and waterworn. The cracks and rounded edges are due to this process.

The upper row of figures shows that the occlusal surface of the *Hesperopithecus* molar is more or less intermediate in contour between m^3 and m^2 of the chimpanzee.

In the middle row the rounding of the antero-buccal edge of the crown is probably due to extreme wear and subsequent erosion; so also the bluntness of the root ends. The enamel on the lingual surface, unlike that of the chimpanzee here figured, is not reflected upward along the neck of the tooth. The lingual root (1) was extremely robust.

In the lower row we see the site of the postero-external (disto-buccal) root, which has been broken off and the site subsequently smoothed down by erosion.

Fig. 2. In *Hesperopithecus* the antero-external (mesio-buccal) root is very large. The site of the missing postero-external root is also shown, as well as the buccal aspect of the lingual root. The deep fissures and cracks are probably due to erosion.

In the middle and lower rows the great width of the lingual root in *Hesperopithecus* is well shown. The lower row shows the site of the missing postero-external root and the deep groove on the buccal side of the lingual root. The great antero-posterior width of the lingual root, as well as the extreme wear of the occlusal surface, indicates that the tooth is an m^2 or m^1 rather than an m^3.

Fig. 3. The evenly concave wearing surface of the *Hesperopithecus* molar is seen to resemble that of *Pithecanthropus*. In the upper row we note the far greater antero-posterior diameter in *Pithecanthropus*, which has a very large hypocone.

The righthand figures in the upper and middle rows represent the second upper molar of an American Indian, which has been artificially ground down to near the base of the crown. The appearance of this tooth indicates that the rounding of the edges in *Hesperopithecus* may be due to erosion, since similar erosional features have been produced experimentally in the modern tooth. Secondly, it shows the rapid lessening of the antero-posterior diameter of the inner or lingual side of the tooth near the base of the crown.

The middle row shows the doubling of the antero-external (mesio-buccal) root in *Pithecanthropus* and the extreme divergence of its inner and outer roots. In *Hesperopithecus* the lingual root is much wider transversely than that in the human molar and the antero-external root is narrower. The lack of a sharp reflection of the enamel toward the lingual side is seen also in the human molars here figured.

The lower row shows well the even concavity of the wearing surface in *Hesperopithecus* and *Pithecanthropus*. The divergence of the lingual and buccal roots is greater than that in the human molar figured.

Fig. 4. In the upper row we see the doubling of the antero-external root in *Pithecanthropus*, this root being single in *Hesperopithecus* and in the human tooth here figured. The grooving of the lingual root in *Hesperopithecus* is well shown, also the markedly asymmetrical contour of the crown as seen from above. This view especially, together with *2*, lower row, affords evidence that the type specimen of *Hesperopithecus* is an upper molar of a member of the anthropoid-man group.

In the middle row considerable resemblance to the second upper molar of *Pithecanthropus* and to the first upper molar of an American Indian is shown.

In the lower row the Indian molar (m^2), which had been artificially ground down to near the base of the crown, is compared with the unground but worn second molar of the opposite side. (Compare *fig. 3*, upper row, with the remarks above.)

III. REMARKS ON THE COMPARATIVE MEASUREMENTS AND INDICES OF HESPEROPITHECUS

(Cf. Tables 1 and 2, and Figures 1–4)

The type upper molar of *Hesperopithecus* approaches the third upper molar of a certain chimpanzee in the general dimensions of the base of the crown, that is, in four measurements, (a), (b), (d), (e), and in two indices, 1, 4. This is the greatest number (six) of agreements recorded in the table. It differs from the same in the much greater relative width of the posterior moiety of the crown (index 2), in the much greater relative antero-posterior diameter of the lingual root (index 5), and in the lesser divergence, or forking, of the lingual and antero-buccal roots (h).

It approaches the second upper molar of the same chimpanzee in the transverse diameter of the posterior moiety of the crown (c), in the angle of the outer surface of the crown to the anterior surface (f), and in the degree of divergence of the axis of the lingual root to that of the antero-buccal root (h). All these are important points in favor of the view that the type is an m^2 rather than an m^3.

TABLE 1

Comparative measurements and indices of Hesperopithecus

Type m^2 (?)

	HESPEROPITHECUS TYPE m^2?	CHIMPANZEE A. M. N. H. 51278 m^2	CHIMPANZEE A. M. N. H. 51278 m^2	PITHECANTHROPUS CAST m^2	AMERICAN INDIAN A. M. N. H. 2161 m^2 CROWN GROUND DOWN	AMERICAN INDIAN A. M. N. H. 2161 m^2 NATURAL WEAR	AMERICAN INDIAN A. M. N. H. 22166 m^1 NATURAL WEAR
(a) Antero-post. diam. middle of crown at base (mm.).....	10	10	11.5	12	10	10.2	10
(b) Distance inner base protocone to outer base paracone (mm.)..	12	12	13	13.4	12.2	12.5	12.3
Index 1: relative transv. width ant. moiety of crown $\left[\frac{(b) \times 100}{(a)}\right]$	120	120	113	112	122	123	123
(c) Distance inner base hypocone to outer base metacone (mm.)...	10.2	9	10.7	11.5	11.5	11.8	12
Index 2: relative transv. width post. moiety of crown $\left[\frac{(c) \times 100}{(a)}\right]$	102	90	93	96	115	116	120
(d) Distance ant.base par acone to post. base metacone (mm.)....	10.5	10.2	11.8	12.2	10.8	10.8	11.2
Index 3: relative ant.-post. diam. outer margin of crown $\left[\frac{(d) \times 100}{(a)}\right]$	105	102	103	102	108	106	112
(e) Distance ant. base protocone to post. base hypocone (mm.)..	9.3	9.2	10.5	11.7	9.5	10	9.8
Index 4: relative ant.-post. diam. inner part of crown $\left[\frac{(e) \times 100}{(a)}\right]$	93	92	91	97	95	100	98
(f) Angle of outer border of crown to ant. border.....	62°	68°	60°	60°	70°	70°	70°
(g) Ant.-post. diam. lingual root (mm.).....	6.8	5	6.2	7.7	5.7	5.7	6.5
Index 5: relative ant.-post. diam. of lingual root $\left[\frac{(g) \times 100}{(a)}\right]$....	68	50	54	64	57	56	65
(h) Angle of axis of lingual root to that of anterobuccal root.....	21.5°	25°	22.5°	m^2 27° m^3 35°	5°	5°	18°

TABLE 2

Data on the variability of the angle of the axis of the lingual root to that of the antero-buccal root in human molars

AM. IND. 2161* m^2	AM. IND. 22166 m^2	BEDOUIN 7224 m^2	AM. IND. 22166 m^1	AM. IND. 22165 m^1	BEDOUIN 7224 m^1	WHITE MAN m^1 (?)
5°	13°	14°	18°	43°	18°	28°

* The numerals immediately above the symbols for molars refer to the identification numerals on the corresponding specimens in the American Museum of Natural History.

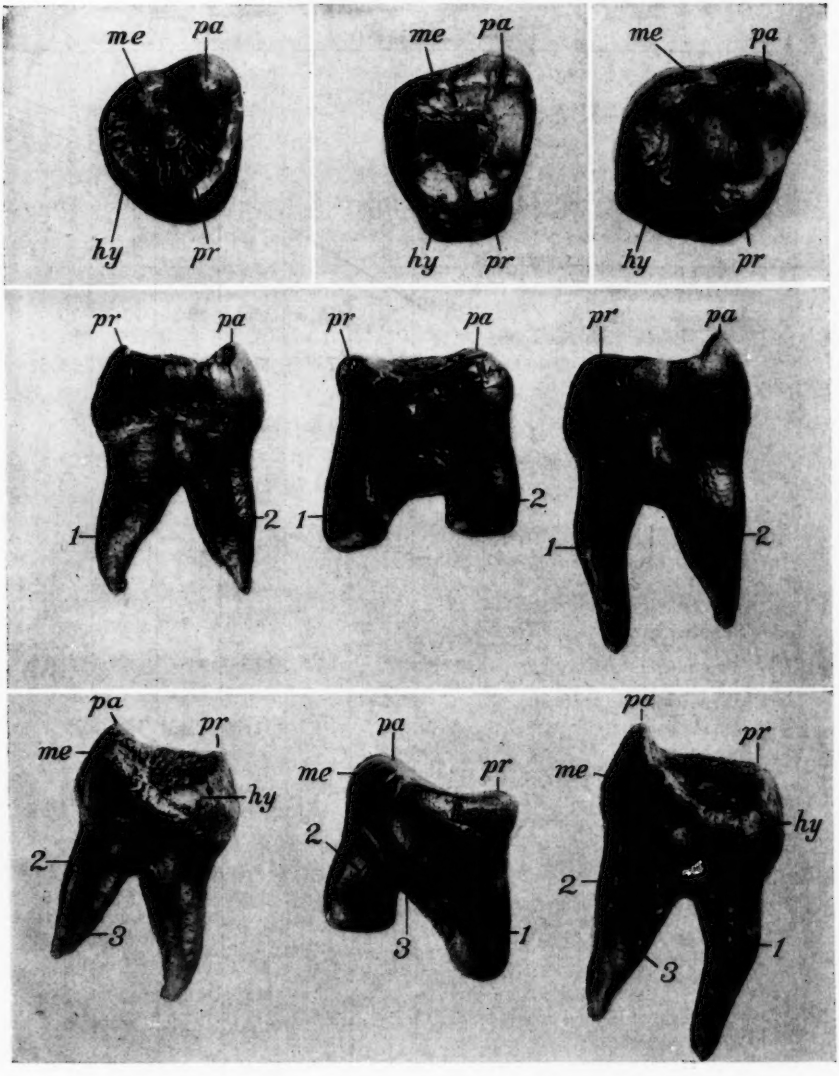

FIG. 1. COMPARATIVE FIGURES OF UPPER MOLARS OF *Hesperopithecus* AND MODERN CHIMPANZEE (*Pan schweinfurthii*). × 2

Upper row: occlusal aspect, third upper molar of chimpanzee, second (?) upper molar, type of *Hesperopithecus*, second upper molar of chimpanzee.

Middle row: anterior (mesial) aspect of same specimens.

Lower row: posterior (distal) aspect.

Pr, protocone (mesio-lingual cusp); *pa*, paracone (mesio-buccal); *me*, metacone (disto-buccal); *hy*, hypocone (disto-lingual).

1, lingual root; *2*, antero-external (mesio-buccal) root; *3*, postero-external (disto-buccal) root, or site of same.

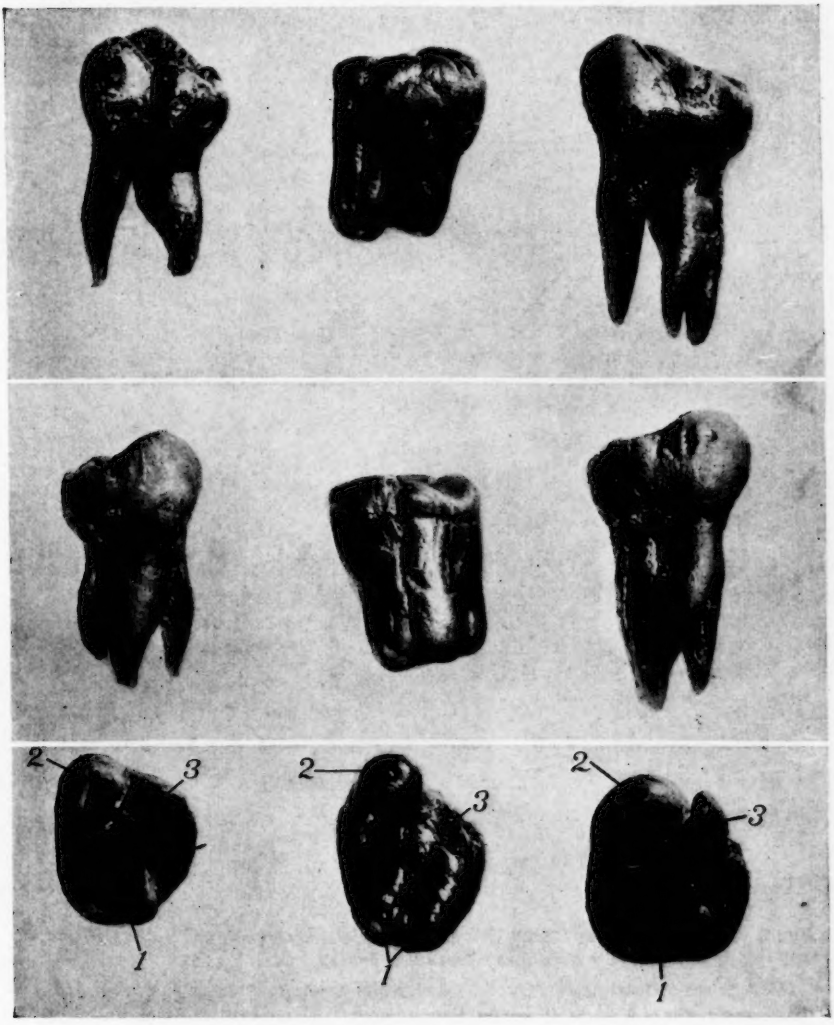

FIG. 2. COMPARATIVE FIGURES OF UPPER MOLARS OF *Hesperopithecus* AND MODERN CHIMPANZEE (continued). × 2

Upper row: buccal aspect; m^3 chimpanzee, m^2 (?) *Hesperopithecus*, m^2 chimpanzee.
Middle row: lingual aspect; same series.
Lower row: view from above, showing roots.

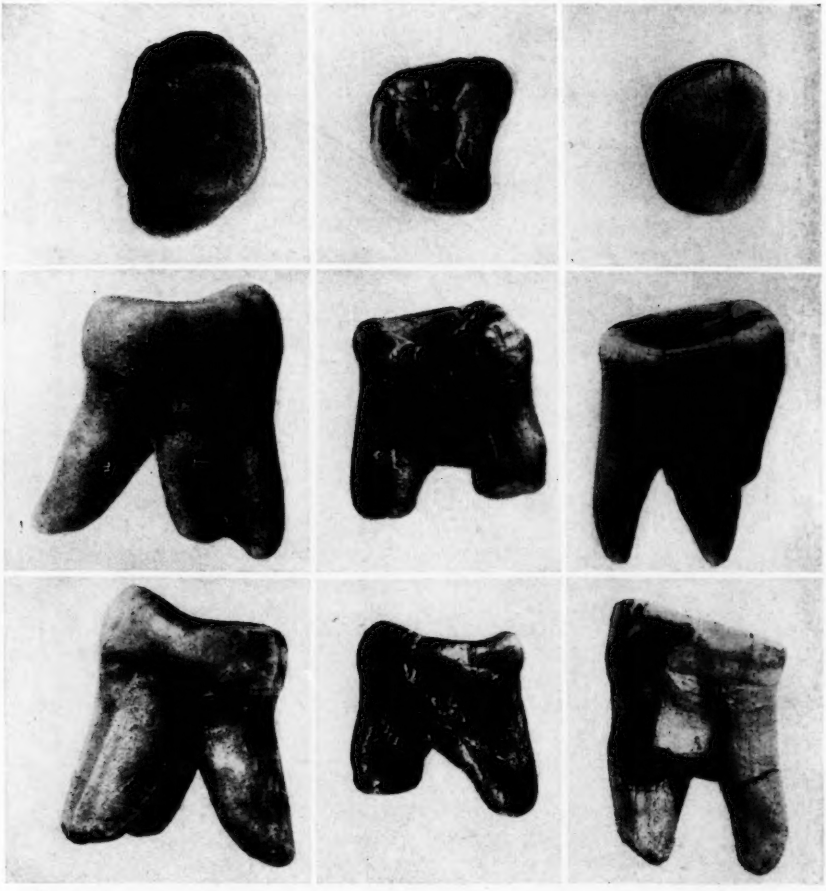

FIG. 3. COMPARATIVE FIGURES OF UPPER MOLARS OF *Pithecanthropus*, *Hesperopithecus*, AND MODERN AMERICAN INDIAN. × 2

Upper row: occlusal aspect; second upper molar (cast) referred to *Pithecanthropus*, type upper molar of *Hesperopithecus*, and second upper molar of modern American Indian (ground down to near base of crown).

Middle row: anterior or mesial view; same series.

Lower row: posterior or distal view; *Pithecanthropus*, *Hesperopithecus*, and m^1 American Indian.

FIG. 4. COMPARATIVE FIGURES OF UPPER MOLARS OF *Pithecanthropus*, *Hesperopithecus* AND MODERN AMERICAN INDIAN (continued). × 2

Upper row: view from above, showing roots; second upper molar (cast) referred to *Pithecanthropus*, type upper molar of *Hesperopithecus*, first upper molar of American Indian (postero-external root broken off).

Middle row: lingual aspect; same specimens.

Lower row: occlusal aspect; molars of American Indians. Second upper molar ground down to near base of crown; second upper molar of opposite side, natural wear; first upper molar much worn.

The type upper molar of *Hesperopithecus* differs from the m^2 (cast) of *Pithecanthropus* in nearly all the absolute measurements, but approaches it in the great size of the lingual root (index 5), in the angle of the outer side of the crown to the anterior side (f), and especially in the evenly concave form of the grinding surface.

While approaching the second upper molars of certain American Indians in four absolute measurements, (a), (b), (d), (e), and in two indices, 1, 3, the type upper molar of *Hesperopithecus* differs widely in the more asymmetrical form of crown with narrower posterior moiety (index 2),[3] in the greater size of the lingual root, and especially in the greater divergence of the lingual and antero-buccal roots,[4] and in the smaller transverse diameter of the antero-buccal root.

The marked asymmetry and small transverse diameter of the posterior moiety are pronounced in the second upper molar of the "Mousterian youth" of the Neanderthal race.

The type of *Hesperopithecus* approaches the first upper molar of a certain American Indian (table 1) in three important characters, (a), (g), and index 5.

IV. RADIOGRAPHIC EXAMINATION OF TYPE SPECIMEN

Doctor George Palmer Ratner, D.D.S., has kindly submitted the following report (New York, August 25, 1922):

"Under radiographic examination the specimen submitted has the appearance of a molar tooth, i.e., crown portion and two roots; mesio-buccal and lingual; disto-buccal apparently missing. Occlusal aspect discloses pulp floor having three openings for three independent roots.

"There is present the pulp chamber in crown portion of tooth, also

[3] The apparent asymmetry and relative narrowness of the posterior moiety of the crown in the type may be due in a considerable degree to the advanced condition of wear in the region of the hypocone. A difference of this character may be noticed in the comparison of a less worn and a more worn second upper human molar of the same dentition (*fig. 3*).

[4] There is, however, a wide range of variability (from 5° to 43°) in this character in man (see table 2).

outline of one pulp in mesio-buccal root, terminating in two foramina. Large root, or lingual, discloses two independent pulps present in this root."

FIG. 5. COMPARATIVE RADIOGRAMS OF UPPER MOLARS OF CHIMPANZEE, *Hesperopithecus* AND AMERICAN INDIANS

Upper row: vertical projection; chimpanzee m^3, chimpanzee m^2, *Hesperopithecus*, American Indian m^2, American Indian m^1.

Middle row: antero-posterior projection; chimpanzee m^2, *Hesperopithecus*, American Indian m^2, American Indian m^1.

Lower row: transverse projection; chimpanzee m^3, *Hesperopithecus*, American Indian m^2, American Indian m^1.

Remarks (M.H.)

Radiographic examination of the type molar tooth of *Hesperopithecus* reveals a triangular outline of the floor of the pulp chamber. At the angles of this triangle, corresponding to the position of the roots,

there are three openings corresponding with the root canals. The lingual root appears to have two independent root canals. The floor of the pulp-cavity is well raised above the bifurcation of the roots, as in man (*fig. 5*). The floor of the pulp-cavity resembles that of anthropoids and man.

V. GEOLOGICAL OCCURRENCE OF THE HESPEROPITHECUS TOOTH

In response to our request, Dr. W. D. Matthew has kindly supplied the following statement:

"This specimen was found by Harold J. Cook in the upper level of the Snake Creek quarries at a point which has been named Olcott Hill, on the ranch of Mr. Harry Ashbrook, twenty miles south of Agate, Nebraska. The Upper Snake Creek at this point consists of sand, pebbles, and numerous fragments of bone, forming irregular lenses, or pockets, on the eroded surface of an older formation, the Sheep Creek beds. They appear to be channel-fill lenses and extend for a distance of about three miles to the westward, cropping out at the heads of a series of little 'draws,' or dry gullies, on the southwest margin of the sand-hill area between the Niobrara and North Platte valleys. Associated with the channel-beds are finer, uniform, clean sands, partly of eolian deposition, partly water-deposited, and varying in thickness from twenty feet to zero, covered by the surface of the plains.

"Fossils are abundant and varied in the channel-beds but mostly very fragmentary and usually rolled or waterworn to a variable degree. Generally they are mineralized to the extent of partly filling the minute canals and pores of the bones, but the larger hollows are either filled with loose sand or empty. The color is usually blue-black from iron phosphate. Sometimes the bones are mottled light yellow, or completely dead white, and the degree of mineralization varies to a considerable extent.

"The finer sands contain the same or a slightly later faunal phase but fossils are rare in them, although apt to be well preserved when found.

"The fauna found in these upper Snake Creek beds has been extensively collected and carefully studied by the writer, Harold Cook, and others. It appears to be a unit fauna and of Lower Pliocene age, save for occasional specimens of the Upper Miocene Lower Snake Creek fauna, presumably due to re-deposit. Except for a single specimen, a Bison jaw found on the surface in 1908 (we have no exact record or recollection of the particular circumstances), no fossils have been found at this locality that would indicate

an admixture of Upper Pliocene, Pleistocene or recent faunas. Thousands of Equid teeth have been found, all of the older Pliocene (or Upper Miocene) species, but not one that would suggest Pleistocene age. In view of the great number of fossils it is safe to say that no Pleistocene admixture is present.

"As regards the *Hesperopithecus* tooth, it was found by Mr. Cook in place in the Upper Snake Creek channel-beds; and, as the finder is an experienced geologist and palæontologist, thoroughly familiar with this fossil locality and the fauna, his reports and conclusions are considered exceptionally valid proof of its occurrence. The preservation of the tooth is entirely normal and similar to those of the rest of the Upper Snake Creek fauna.

"The following list of the associated fauna is not complete, but suffices to show its relations

"Carnivora
- Ursidæ—*Hyænarctos* sp.
- Mustelidæ—*Brachypsalis* sp.
- Canidæ—*Aelurodon haydeni* var.
- " *saevus* var.
- Felidæ—*Machærodus* sp.

"Perissodactyla
- Equidæ—*Pliohippus leidyanus*
- " cf. *mirabilis*
- *Protohippus* cf. *perditus*
- " *placidus* var.
- *Hipparion affinis*
- " *gratum* var.
- Rhinocerotidæ—*Peraceras* sp.
- *Aphelops* sp. indesc.
- *Teleoceras* cf. *fossiger*

"Artiodactyla
- Dicotylidæ—*Prosthennops* cf. *serus*
- Camelidæ—*Alticamelus* cf. *procerus*
- *Pliauchenia gigas*
- ?*Procamelus* sp.
- Cervidæ—? *Cervavus* sp.
- Antilocapridæ—? *Merycodus* sp.
- Bovidæ—*Neotragoceras improvisus*

"Edentata
- Megalonychidæ—*Megalonyx* cf. *leptostomus*

"Glires
Sciuridæ—*Sciurus* cf. *aberti*
Mylagaulidæ—*Mylagaulus* sp.
Geomyidæ—*Thomomys* sp.
"Proboscidea
Mastodontidæ—*Miomastodon matthewi*
Trilophodontidæ—? *Trilophodon* sp.
"Insectivora
Talpidæ—*Scalops* sp.

"The above fauna is comparable with that of the Republican River of Kansas, Nebraska and Colorado; with the Rattlesnake of the John Day basin in Oregon; the Thousand Creek beds of Nevada; and various early Pliocene formations in the western United States. These are regarded by Osborn, Merriam, and the writer, as a practical equivalent in a broad way of the *Hipparion* fauna of Europe and Asia, which is assigned by most authorities to the Lower Pliocene.

"The above data are considered by the writer to furnish fairly conclusive proof of the Lower Pliocene age of the *Hesperopithecus* tooth. There is no reasonable doubt as to its age."

VI. CONCLUSIONS

1. The differences from the third lower molar of *Hyænarctus*, with which Smith Woodward[5] suggested that the type upper molar of *H.* should be compared, are so fundamental that it is difficult to find any significant points of agreement. The third lower molar of *Hyænarctus* and of the modern bears has been derived by degeneration of a normal tuberculo-sectorial molar, as may readily be seen by comparison with various amphicyonines and other canids, while the molar of *Hesperopithecus* very clearly conforms to the modified tri- to quadritubercular type that is characteristic of the upper molars of anthropoid apes and man. The illustrations in the plates surely establish this beyond reasonable dispute.

2. The posterior upper molar of the Procyonid carnivore *Cercoleptes* (*Potos*) shows a distant resemblance to the type of *Hesperopithecus*, which does not stand close comparison.

3. There is a certain superficial resemblance of the worn third upper

[5] Woodward, A. Smith, F.R.S. 1922. A supposed ancestral man in North America. *Nature*, no. 2745, vol. 109, p. 151 (June 10).

molar crown of *Lagothrix*, a South American monkey, to the type of *Hesperopithecus*. But in the former the lingual root in old specimens is directed strongly upward and backward, while in the latter it is directed upward and forward, with reference to the general plane of the masticating surface. Moreover, the great differences in size and in the detailed characters of the teeth do not favor the possibility of a near relationship of the two genera.

4. Of the higher primates, the Old World monkeys are excluded from close relationship to *Hesperopithecus* by the oblong contour of the upper molar crown; the gibbons come nearer but have much smaller molars, which are more elongate antero-posteriorly. In the gorilla, the antero-posterior elongation attains an extreme, and this ape also surpasses *Hesperopithecus* in the antero-posterior width of the lingual root and in the degree of its divergence from the outer roots. The orang has quadrate molar crowns with extremely wide lingual roots. The chimpanzees, while varying considerably in molar characters, appear to come nearest to *Hesperopithecus;* but the specimens here figured differ from it in the weakness of the roots, in the lingual reflection of the enamel upon the neck, and in the greater relative antero-posterior diameter of the crown (assuming that the type of *Hesperopithecus* is either an m^2 or an m^1).

5. Our results thus afford additional evidence in favor of Professor Osborn's conclusion[6] that the type of *Hesperopithecus haroldcookii* represents a hitherto unknown form of the higher primates. It combines characters seen in the molars of the chimpanzee, of *Pithecanthropus* and of man; but, in view of the extremely worn and eroded state of the crown, it is hardly safe to affirm more than that *Hesperopithecus* was structurally related to all three.

6. Whether *Hesperopithecus* itself is or is not ancestral to man can only be determined by subsequent discovery; but meanwhile the only part definitely known of it, namely, the much worn type upper molar, represents a stage of evolution which comparative morphological evidence indicates as preceding the following definitely human specializations: (a) the reduction of the lingual root; (b) the lessening of the divergence of the lingual and buccal roots; (c) the widening

[6] Osborn: Op. cit.

of the antero-external root; (d) the antero-posterior shortening and transverse widening of the crown; (e) the tendency toward rectifying the asymmetry due to the narrowness of the posterior moiety of the crown. The *Hesperopithecus* molar shows the opposites of all these characters and such an assemblage of primitive features has not hitherto, so far as we are aware, been found in any single human molar.

7. The anatomical, palæontological, and other evidence[7] already accumulated tends to show that man, *Pithecanthropus*, *Hesperopithecus*, and the various anthropoids, form a natural superfamily group, which may now be named the Hominoidea, in contrast with the Cercopithecoidea, or Old World monkeys.

8. The palæontological, anatomical, and taxonomic evidences, considered together, indicate that the stem forms of this group arose in the early Tertiary times from primates that were closely allied or identical with the Lower Oligocene *Parapithecus*, which in turn, so far as known, shows a remarkable mingling of characters tending to connect the whole Old World series of primates with the stem of the Eocene tarsioids (Schlosser, Gregory).

9. There was a wide adaptive radiation of this group in the Middle Tertiary, very diverse species having been found fossil in western and eastern Europe and India. *Hesperopithecus* was one of the Lower Pliocene survivors of this group, which had apparently spread northeastward along the route followed by various mastodons, antelopes, and other mammals described by Professor Osborn.[8]

10. Finally, the *Hesperopithecus* molar adds another small item to the enormous mass of evidence from many independent sources, in support of Darwin's conclusion that man is merely a highly specialized derivative of some ancient member of the "anthropomorphous subgroup" of Old World primates.

[7] See W. K. Gregory, "The origin and evolution of the human dentition," 1921; or the *Journal of Dental Research*, 1920–'21, ii–iii.

[8] Osborn, Henry Fairfield. 1922. *Hesperopithecus*, the anthropoid primate of western Nebraska. *Nature*, Aug. 26, 1922, p. 281. For a fuller discussion of the palæontological evidence for the faunal connection of western North America with north-eastern Asia in late Tertiary times, see Matthew, W. D., 1915: Climate and evolution, pp. 234–255; also Matthew and Cook, 1909: A Pliocene fauna from western Nebraska, pp. 367–390, 413.

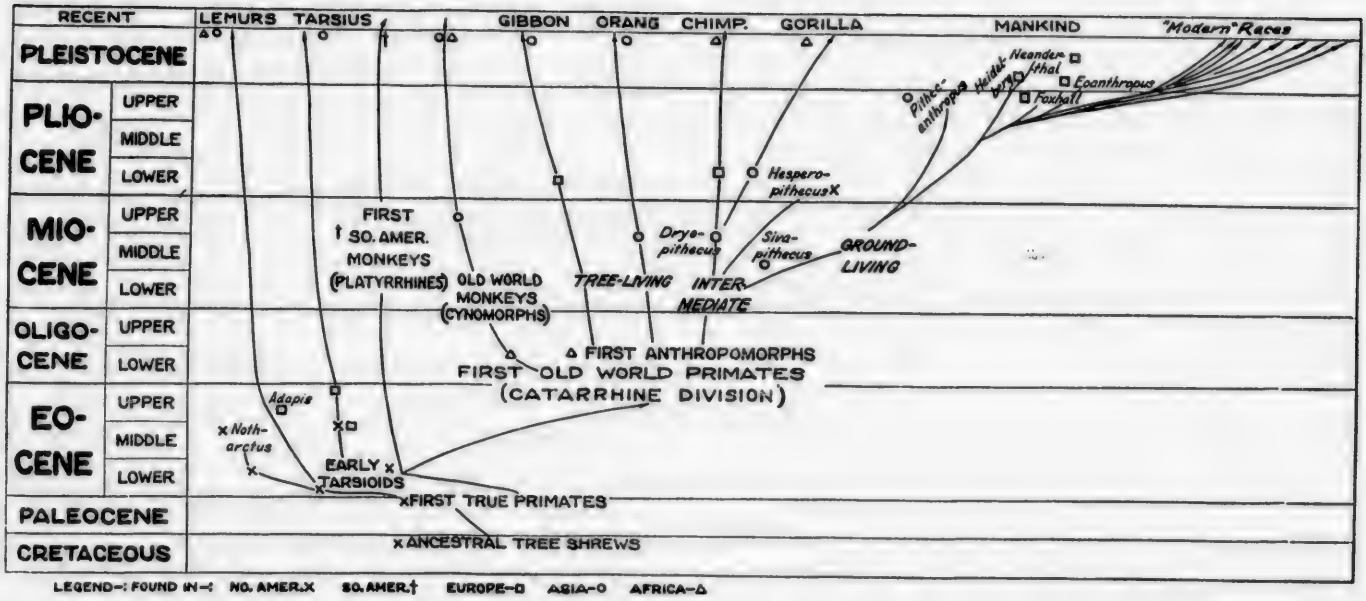

FIG. 6. GEOLOGICAL SUCCESSION AND RELATIONSHIPS OF THE PRINCIPAL TYPES OF PRIMATES, ACCORDING TO PRESENT EVIDENCE FROM PALAEONTOLOGY, COMPARATIVE ANATOMY, ANTHROPOLOGY, ETC.

(W. K. GREGORY, 1922.)

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CONSERVATISM IN PARTIAL PROSTHETIC RESTORATIONS[1]

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The choice of title for this paper was dictated by two considerations: first, the tendency, in our profession, to select, for partial prosthetic restorations, methods that are complex, where simple procedures may serve our patients well; second, the fact that confrères for whose opinions I have respect have told me, after seeing cases in practice, that I have been remiss in not reporting the results of my usage of certain simple appliances and principles.

In setting before you my opinions and experiences, within the limitations of these two major headings, I shall show slides, from models of actual cases, of prosthetic restorations, with the use of partial-denture bridges and a technic that I hold to be broadly applicable. I shall present my reasons for considering this type of restoration superior, for a large percentage of our cases, to any fixed bridge, or any other type of removable bridge. With these slides, I hope to make plain to you the usage of the appliances described, so that any competent technician can adopt them, if he so desires.

Every one in this audience will admit without argument that, with few exceptions, teeth missing from the human dental arch should be replaced with artificial substitutes, to the end that the integrity of the masticatory function may be preserved and that the drifting, tipping and extrusion of the teeth, and the traumatic occlusion that always follows the loss of even a single tooth, may be minimized. With this assumption, let us pass on to the consideration of the means at our command for rendering that service. It is a matter of constant comment that, as a profession, we are prone to follow the latest new idea; to seize upon each new discovery or alleged discovery; and to grasp each new device, new theory, or new develop-

[1] Read at a meeting of the New York Academy of Dentistry, at the New York Academy of Medicine, on October 18, 1922.

ment in technic, turn it into a fad to be ridden beyond the bounds of reason and, frequently, to be discarded in favor of something new, where our patients' best welfare would dictate its continued use.

I do not think we are singular in this. I note indications that practitioners of medicine are subject to the same tendency. We are, perhaps, more exposed to temptation in that line, because our procedures are not well standardized and because of the greater opportunity for the introduction of mechanical devices in our work. How often we have been exploited because of this characteristic! And how many millions it has cost us! What a junk pile the collective results of our enthusiasms would make, if we could assemble them in one spot! This temperamental manifestation is of infinitely less consequence, however, when displayed in the collection of new mechanical devices, than it is when we let some new and attractive procedure, be it mechanical or surgical in its nature, upset our sense of proportion, and cause us to disregard in toto well seasoned methods in favor of the new and untried.

We are prone to run after strange gods with much enthusiasm. One of our great surges in that line was the craze for the fixed bridge. How enthusiastic the profession was over its possibilities, and with what fervor many of us repudiated it when our eyes were opened. Whether the fixed bridge will ever regain a generally honored position with the profession is doubtful; but, stripped of its more evil companions—slipshod technic, septic root-canal therapy, and the results of deficient judgment in selecting its field—it is coming to be recognized, by some thoughtful practitioners, as a "fairly respectable citizen," within strict limitations. I confess, with some sense of chagrin, that not many years ago I endorsed the statement that there is no place in dentistry for the fixed bridge. At that time, I was strongly influenced by the claim that teeth must have *all* their opportunity for individual movement (so-called) unimpaired in order to be safe. I learned much from the cases I studied for the survey of fixed bridge work" published in the *Dental Items of Interest* a few years ago. One thing that I learned was that the type of bridge which is fixed at one end only and supported at the other by a rest or lug, when of small size and placed in cleanly mouths on teeth of good integrity, whether vital or pulpless, with avoidance of mechani-

cal irritation to vascular tissues, is capable of surprising service. I have records of such bridges of twenty and one of twenty-five years' standing; and the abutments appear to be as sound as when the bridges were placed or, at worst, to have suffered no more deterioration than is common to all the teeth of the individual mouths in which they stand.

I doubt not that present-day radiographs of the highest class will show evidence of tissue changes around and between the abutments, but I hold that evidence in slight esteem, as compared with the fact that the physical condition indicates vitality sufficient for more decades of service. I also gained a fresh realization, from the cases I contributed to that survey, of the unwisdom of any kind of appliance or extension attachment, to any tooth, in another class of mouths. I am well convinced that in mouths prone to sordes deposits, in subjects displaying evidence of intestinal toxemia or of established organic disease, the uniting of two or more teeth, the mounting of a Roach Attachment of a Gilmore Bar, the placing of a band of any type at the gingival margin—even the abnormal inlay contour that the most enthusiastic and painstaking removable or movable removable bridgeworker occasionally seems to find necessary in order to include the box of his bridge attachment—often starts a train of events that quickly brings the teeth involved to an intimate acquaintance with the forceps. It is this possibility, rather than the risk from "semi-fixation," that has checked me in the use of fixed bridgework in recent years. No dentist may venture to say what a decade may bring to his seemingly healthy patient, and I do not doubt that any one of the cases that I speak of as a success can quickly be turned into a failure by the incidence of any one of several organic diseases.

The rigid and complete fixation of two or more teeth to each other I view with distrust, in spite of the cases on record of long service from such bridges. In the present state of my knowledge, after careful reflection, I am of the opinion that semi-fixation can be utilized in selected cases, with safety, provided cleanliness can be assured and traumatic occlusal stress reasonably well eliminated. It is not my intention, however, to argue in favor of general use of fixed bridgework. The cases suitable for its use are in my estimation not over five per cent of those needing our care, and I believe we can do

better and safer service for a considerable part of that limited number. I have given this much attention to the semi-fixed appliance merely to indicate my belief that even the conservative operator may find places where its use will be for the best interest of his patient, and to place on the record rebuttal evidence that the minor indications of mere abnormality claimed to be invariably discoverable by present-day radiography, in cases where fixed bridgework has been used, are not necessarily to be interpreted as of capital importance.

The examples shown to prove that all bridgework that cannot be removed from the mouth, and that all bridgework not movable when in the mouth, injure the patient, have often carried evidence of the existence of other plausible explanations for the failures. With careful selection and where careful technic has been practiced, followed by many years of successful service of a fixed bridge accompanied by a continuing sound condition of the supporting abutments sufficient to lead the experienced practitioner of keen perception to anticipate further long terms of service, there is reason for skepticism as to the wisdom of *universal* condemnation of the fixed appliance; and it takes but few such cases to compel review of the evidence on which the fixed appliance has been condemned.

But I am devoting too much time to the fixed bridge, the misuse of which I meant to cite as an example of the need for conservatism. Perhaps my citation of the evidence that it is less black than it has been painted, coupled with my reasons for indicating an exceedingly narrow field of usefulness, is a sufficient argument for conservatism in its use.

As the enthusiasm for the fixed bridge began to fade, and well balanced practitioners realized how weak a reed they had been leaning upon, the removable bridge became the new pet, conservatism was again forgotten, and history repeated itself. Removable bridgework suffered not only for its own inherent defects, but for the same reasons I have cited in connection with the fixed bridge. Poor judgment in selecting cases, incomplete study and diagnosis of conditions, slipshod preliminary treatment of abutments, and disregard of mechanical principles and mechanical excellence in execution, all took toll of our patients' precious teeth, and the infant prodigy soon became a mighty troublesome "kid" to manage.

About this time an outside influence stepped in—Hunter's arraignment of the dental profession jolted us hard. Among other effects, it stimulated the search already well under way for means to eliminate the factors of danger in our bridgework. Those really skilled and experienced in the use of the one well known early type of removable bridgework redoubled their care along all lines and have held their own, but the sound reasons for avoiding pulp removal where possible resulted in many new types of bridge attachment till we were flooded with them. Many of them have served a good purpose in removing from the field two factors of disaster in the hands of the slipshod. It became less necessary and more unpopular to remove so many pulps, and casting processes and small attachments made possible the elimination of much of the previous unfortunate operative disturbance of gingival margins in doing the work, and of much of the foreign material and consequent irritation in that location. The removable bridge also made it possible for the patient, earnestly so desiring, to keep both tissues and appliance clean, where cleanliness had been difficult or impossible with the fixed appliance. But we, as a profession, again lost our sense of proportion as research in focal infection led to more extractions, and consequent need for more bridges. The removable bridge became so popular and universal that we found our patients accepting them rather as a matter of course, and comparing notes with each other as to the respective advantages of different types. Under this stimulus, far too many bridges of a type calling for anchorage elements, deeply seated in vital dentine, were made, many of them with great mechanical nicety; but in this field, as in others, the unskillful and slipshod still took their toll.

The backers of the "movable removable" system very sensibly took active steps to teach their followers to avoid the errors of bad root-canal work, and to avoid the need for any at all, if possible. They also endeavored to eliminate the poor workman, and some other commercial houses followed suit. As a result, we have seen some improvement in the quality of the work, as the fad for removable bridgework has pursued its course.

Now, let's take account of stock at this point. What is the real situation? I conceive it to be this: We have a limited number of

practitioners who pursue bridgework methods that frequently call for the removal of pulps, who frankly accept the onus for their course, and who defend it as legitimate because of their need for attachments that are stronger than those that can be accommodated in most vital teeth. Some of these men are sufficiently skillful in their pulp work to avoid disaster in that field, and able enough as mechanics, so we need not fear criticism of the profession because of their mechanical results; and, more important still, they are careful diagnosticians, and consequently select intelligently the cases adaptable to their technic.

The great mass of removable bridgeworkers, however, seem to be using one or many of the attachments intended for vital teeth. These all have one common characteristic, which I believe is limiting their usefulness. Those that can reasonably be used in vital teeth are all small enough to be weak mechanically. Those of adequate strength are all so large that their use involves cutting deeply enough into vital dentine to invite pulp pathology, or that is avoided at the expense of abnormal plus contour of anchorage inlays, and a consequent invitation to gingival and pericemental pathology. I have yet to see a split attachment for use in vital teeth that I consider small enough to be safe, and at the same time strong enough to withstand the jaw-muscle thrust of the vigorous subject. Added to these hazards, the conservative man is in a dilemma for another reason. Most of the advocates and practitioners of removable bridgework find the difficulties, hazards and actual costs of such work, when well performed, to be such that even the wealthy consider it a luxury. Some of the advocates of the movable removable type tell us that it is easy and simple to do, but what I hear of their fees does not bear out that contention.

Please do not misunderstand that last statement. I have no disposition to criticise high professional fees, if adequate service has first been rendered. Assuming high-class professional service, I hold that the fee may be properly considered solely a matter between practitioner and patient. A practitioner who exacts a large or very large fee for an *ordinary* service, or for service that is below the standards of good dentistry, is not justified, and does his profession and his patient an injury.

If the above is a fairly true statement of the real situation, then what is the conservative practitioner, greatly concerned for his patients' welfare, to do when the need arises for partial prosthetic substitutes? His conservatism bars him from pulp removal, and from deep cutting of vital teeth. That same conservatism has probably attracted a clientele of similar type of mind. The conservative operator, confronted with the need for supplying a substitute for upper bicuspids, the cuspid being sound and without blemish, or for supplying mandibular molars on one side only, all other teeth of the mandible present and all pulps healthy, cannot bring himself to cut deeply enough for anchorage of removable attachments in such a cuspid, nor can he do what was recently shown with apparent self congratulation in a New York Office, in which the standards should be high, namely, pulp removal in both biscupids, and an extension saddle with anchorage on the bicuspid roots. When such methods come in, conservatism has faded away. Also, there is that great need for ways and means to help those with more modest purses, for whom the prices imperative for well constructed removable bridgework are prohibitive. For these cases, and a great many others, I believe the correct choice to be the partial-denture bridge, an appliance having the general appearance of a partial denture, but utilizing the principle of the bridge in carrying rests or lugs of the Bonwill type, and utilizing some of the remaining teeth in the mouth to help to carry the thrust of the jaw muscles in mastication. Personally, as a matter of convenience, I have called all appliances bridges, if they utilized natural teeth as supporting abutments, but that usage of the term seems to arouse criticism in the minds of some.

I believe there are sound reasons, having to do with our patients' welfare, for considering that all abutment supported partial dentures are really bridges. Human psychology is such that we all want credit for possessing the best in any line. With the laity "plates" are in disrepute for well known reasons; denture is an unknown, while bridge is a well known term, and is in such common use, and moreover, has been so steadily advocated, that the public accepts it as a rather creditable thing to possess a bridge. Therefore, it is oftener much easier to reconcile a patient to the loss of an offending tooth, if they be assured that it can be replaced with a bridge. In my estimation, the use of

natural teeth as abutments makes any artificial substitute, to all intents and purposes, a bridge. It is a more convenient term to use. The only objection I can conceive to its use, for any and every type of appliance which utilizes abutment support in any way, is the fact that the charlatan has sometimes used it, and may continue to do so, as a reason for increasing his fee. It is probably unnecessary to say that I have not found occasion to use it designedly for that reason.

In my estimation, it is unfortunate that the partial denture has fallen into disrepute in the profession and also among our patients. Just as the amalgam filling served more people, and served them well, in the days when the good foil filling was our highest type of achievement, so the intelligently used partial denture, with inclusion of stabilizing abutment rests, can be made of greater service to more people than any of the types of bridge we know of now. I am convinced that it offers superior advantages for many cases where cost is not a factor. I shall show, on the screen, several cases where I feel that it has rendered service that no other type of bridge yet introduced could have duplicated, and with much less destruction of sound teeth.

The partial denture has suffered in repute partly for the reasons cited in my comments on fixed bridgework: unintelligent planning, misuse of clasps, and lack of earnest determination to get the best out of it. Some of our abler practitioners have continued to use it, improving its plan step by step, since the days of Bonwill, who made the most notable early advance in supplying the so-called Bonwill lug or rest, until today I consider it a competitor for the place of honor in partial prosthetic restorations. I believe that the same amount of energy and ingenuity that we have devoted to devising new bridge attachments, and learning to use them, if concentrated on improving the partial denture and its attaching and supporting devices, would have prevented it from ever falling into disrepute. We all know that a certain type of partial denture, without lugs and with wide clasps placed near or in contact with the gingiva, has done and today is doing much damage, but that type of denture should have been obsolete long ago.

One of the marked advantages of the denture bridge is the ease with which it can be repaired, if its only weak member—the clasp—needs

that attention. To your sorrow, many of you know this is often not the case with the split attachments.

Dr. F. T. Van Woert helped me to come to my senses in this field, some years ago, when he said to me that he "made very few large bridges of any kind for patients whom he desired to keep." Dr. F. R. Getz (2), in 1915, and Dr. W. E. Cummer (1), a few months later, presented valuable articles on the technic of the partial denture or partial denture-bridge, or bridge as I shall call it from now on.

The so-called Bonwill bridge utilized, in a crude way, two valuable principles that are essential to this form of bridge, namely, the lug or rest and the clasp. The clasp was one of the earlier devices of dentistry, it is still one of our simplest, and can be one of our most reliable devices. In conjunction with a correctly made lug, it is the retaining device that can be used in a great majority of instances, on natural teeth, with the least harm to them either from operative interference with their structure at the time of application, or from deleterious influence in the decades that follow. Moreover, if harm does follow the use of such a clasp, it is easily and simply repaired.

The clasp has fallen into disrepute for several reasons; wide flat clasps retain food and debris in contact with enamel, and induce decay; clasps of any sort impinging on gingival tissues, induce disease there; narrow clasps, without stabilizing elements for the artificial piece, cause grooves to develop at the point of contact, largely due to friction as the piece moves under impact of opposing teeth. Damage done by the narrowest clasp of all, namely, the round wire clasp, is the least deleterious and easiest remedied, when the clasp has been correctly placed and a stabilizer added. It is also the one that can most easily have any prospective damage forestalled, if the exigencies of the case demand placing it at a point susceptible to caries or erosion. It is the easiest clasp of all for the technician to shape, and the one that can have its point of attachment to the bridge farthest from the point where its grip on the tooth is desired, so giving opportunity for taking full advantage of the natural resiliency of the clasp metal. This latter fact renders it rarely necessary to use hinged attachments (3, 5) for such clasps, since it is usually possible to so shape and attach the clasp that it can slip over the largest part of the tooth, or over somewhat malposed teeth, without deforming the clasp, thus avoiding inter-

ference with its fit at the point where fit is desired. Such clasps can be so placed when used on extension bridges, as to serve as efficient retainers, and still avoid "pump handle" leverage on the teeth to which they have been applied.

If this is true, then the plain course for the conservative man is to add a stabilizing element that shall keep the whole bridge from playing back and forth, except within narrow limits, and so shape his round wire clasp as to get the full value of its resiliency for retentive purposes. This is not difficult, and the procedures involved call for the removal of a minimum amount of tooth substance, and that of a character rarely leading up to pulp irritation of consequence.

My first usage of this type of clasp that I can now trace, was in 1905, and the idea was adapted from the crib clasp of the Jackson System of Orthodontia. It was used to solve the problem of supplying the missing molars from the left side of the mandible, without extending the piece beyond the left cuspid. The piece made then is still doing excellent service, and its model will be shown in the slides. (In the same mouth is a bridge fixed at one end and supported at the other; placed there 25 years ago; still doing good service, and never having been disturbed since. I hope to get a good radiograph of its abutments this winter.)

Until recent years, and since I have taken up increased use of this clasp principle, I had assumed that every one was familiar with the possibilities of the crib clasp. The slides (page lxxx) will give you a clear idea of what I mean by a crib clasp more quickly than I can explain it. It should usually be made of 17 or 18 B and S gauge, round clasp wire, occasionally 16 or 19 gauge may be used. None of the more recent formulae for clasp wire that I have tried approach, in satisfactory service for this work, the No. 1 clasp wire supplied by the S. S. White Dental Mfg. Co. Some of the newer formulae lack resiliency, and will not retain their form, and others are so brittle that they constantly give trouble by breaking.

Study of the case will generally show that at some point there is room for such a wire to pass over the occlusal surfaces in a linguo- or palpato-buccal direction, or that room can be made for it without material damage to the teeth. In case the restoration is of the two upper bicuspids, the preferred place for the crossing of the wire is in

the occlusal embrasure,[2] where the first and second molars approximate. If there is not room without impingement of the tips of the opposing cusps, these can often be shortened a bit without harm. In many cases fillings or inlays exist, or are needed in such places, and under this condition the grooves may be cut as desired, in inlays, for accomodation of the occlusal segment of the clasp.

In a case of this type, the first step is to provide, in the mesio-occlusal aspect of a first molar for instance, where nearly always there is already a filling of some kind, an inlay having in *its* mesio- or disto-occlusal aspect a lug seat approximating a rectangular form, but tapering a little from occlusal to gingival aspect. This lug seat may vary in width and depth, according to the space available, provided only that its cross section assures strength to withstand the stress the thrust of the jaw muscles will impose. Its floor should, preferably, slope away from the mesio-gingival margin of the lug seat, so the tendency will always be for the lug to remain in its seat. In occasional cases a dovetail shape of the lug recess, in cross section, is permissible or desirable, to meet any tendency for the lug to slide out.

The inlay with lug recess having been made, preferably by the indirect process, the lug to fit it is made immediately of a hard gold such as Ney-Oro C, or preferably F, and left unfinished, with a bit of the sprue wire still projecting from its surface. Meantime the saddle has also been prepared from a suitable impression, and inlay, lug and saddle are taken to the mouth and plaster impression taken, with saddle under pressure (or the membrane blanched with adrenalin, if preferred) to obtain the relations of saddle and lug. When these have been united, they are placed in the mouth, and an accurate plaster impression taken from which to make a stone model for fitting the clasp. This model should show perfectly the occlusal embrasure or groove in which the clasp is to lie and, of course, the parts on which its other segments are to rest.

In forming the clasp for such a tooth, place the saddle in its seat, and start a segment of the clasp along its margin, where it lies in con-

[2] This space, lying occlusally to the contact point of adjacent teeth, seems to have received no name from anatomists. After consultation with Dr. J. Leon Williams, Prof. Wm. J. Gies, Prof. W. K. Gregory, and others, I have decided to use the term *occlusal embrasure* as being harmonious with buccal and palatal embrasures, the accepted terms for the spaces in similar relations to the teeth on the buccal and palatal aspects.

FIG. 1

FIG. 2

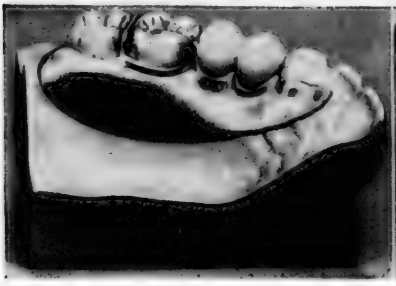

FIG. 3

FIG. 4

FIG. 1. METAL MODEL WITH INLAYS, LUG SEAT, AND GROOVE IN INLAYS FOR OCCLUSAL SEGMENT OF CRIB CLASP

FIG. 2. PALATAL ASPECT OF COMPLETED RESTORATION

FIG. 3. PALATAL ASPECT OF RESTORATION ON MODEL

FIG. 4. BUCCAL ASPECT OF RESTORATION ON MODEL

FIGS. 1–4. The piece shown in *figs. 1–4* is a duplicate of a practical case. The saddle rests against the palatal surfaces of the lateral and cuspid, but those teeth have not been disturbed in any way. The inlays in the molars are no larger or deeper than would be dictated by the requirements for adequate tooth protection. The original of this piece is being worn with the greatest possible comfort and satisfaction by the patient.

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

FIG. 5. MODEL WITH INLAYS AND LUG SEATS

FIG. 6. RESTORATION SHOWING LUG AND TWO-ARMED CLASP FOR THE SECOND MOLAR, EACH CLASP-ARM CONSISTING OF TWO SEGMENTS, AND THE CLASP SOLDERED TO THE LUG IN THE MIDDLE, WHERE IT IS SEATED IN A GROOVE LET INTO ITS OCCLUSAL SURFACE

FIG. 7. ANTERIOR END OF SAME PIECE SHOWING LONGER LUG AND CLASP OF SINGLE ARM, WITH TWO SEGMENTS, AND SOLDERED INTO OCCLUSAL SURFACE OF LUG

FIG. 8. PALATAL ASPECT OF RESTORATION SEATED ON MODEL

FIG. 9. BUCCAL ASPECT OF RESTORATION SEATED ON MODEL

FIGS. 5–9. Observe that the clasp-forms insure that pressure exerted laterally on the end segment of any of these clasps will make operative both rotational elasticity in the segments that stand nearly at right angles to them in the lateral embrasures, and elasticity of flexure in its whole length.

FIGS. 1–9. Most of the clasps on both examples are shown resting a shade too close to the gingival margin. If this were found to be true in the actual case, it could be remedied in a moment.*

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* The Author, the Academy, and the JOURNAL are indebted to Dr. R. Ottolengui for permission to use the blocks for these illustrations, which were published originally by the Author in *Dental Items of Interest:* xlvi, pp. 134 and 135.

tact with the palatal aspect of the tooth; with round or half round pliers, turn it sharply towards the occlusal surface, and shape it so it will stand in the centre mesio-distally of the palatal embrasure, well in towards the contact points of the teeth, but preferably not in actual contact with the teeth. Again bend it sharply so as to have its next segment rest in the embrasure across the occlusal aspects of the teeth, and then again bend it gingivally, so it will stand in the buccal embrasure as described for the palatal embrasure segment. Next carry it along the buccal side of the molar, at the desired location, but always gingivally of the point of highest contour of that aspect of the tooth. If the tooth is one so placed as not to be unduly visible, the wire may be recurved upon itself, to form an open loop, with the final segment placed occlusally to the point of highest buccal contour of the tooth, and the end left free. This sometimes adds to the stability of the smaller saddles.

Perfect this form, and if you are going to attach it to the saddle without another impression, which can often be done, place a layer of heavy tinfoil in the groove, where the occlusal segment rests, fit the clasp carefully to place, seeing that it bears against the teeth in the lateral embrasures but slightly if at all, and that it never rests in a worn, or chipped place in the model at those points. This precaution is to prevent the clasp riding hard where not desired, when taken to the mouth. The tinfoil serves to lift the clasp slightly away; and, after attachment, results in the same relations of clasp, saddle and tooth, as if an impression had been taken under pressure. Note carefully the position of the clasp where it rests against the saddle, and in the groove; lift it off and bend the buccal segment bucally, so it will not prevent removal of the saddle, when waxed to it; replace in its position; attach to saddle with stick wax; remove, invest, solder palatal end of clasp, and bend the clasp back to form. This provides a long resilient clasp of great efficiency, and especially adapted to molars, because of its capacity for bending slightly and evenly through its whole length, and returning to its original shape. If the model used for this step is a good one, and a bite has been taken, no further impression is necessary, for the finishing of the piece.[3]

[3] Consideration of the clasp forms shown in *figs. 1 to 9* will demonstrate that a property of metals is utilized which has received little if any attention in the literature of prostho-

In bridges supplying molars and second bicuspids, where a lug and clasp can be used at each end, the clasp is preferably made and attached, after every other part of the bridge is finished, except the cementing to place of the porcelain. A groove is formed in the occlusal aspect of the lug, also the inlays, if necessary. The clasp is then fitted and soldered to the lug, on its occlusal aspect, leaving each arm composed of two segments. If the buccal arm of such a clasp would be too much in view, it may be omitted, the lug made as deep occlusogingivally as may be safe, and the clasp effect gained by grip of a palatal clasp arm opposed to the lug when in its seat. In the lower cuspid region there is nearly always room for the clasp to go over the occlusion distally to the cuspid, and there I always let the buccal segment end in a Y form to rest on both cuspid and bicuspid. On lower bicuspids a rest on the occlusal surface of the enamel, without recessed inlay, is sometimes sufficient, but the stabilizing influence of the rectangular lug is of great value. In one case that will appear on the screen, room for a molar clasp was gained by cutting a groove into the

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dontia, but which the orthodontists are using extensively in the more modern forms of orthodontic appliances, especially the ribbon and palatal arches; and its value in tending to preserve a condition of perfect elasticity, which is a notable quality of this type of clasp if rightly made, will be evident. I think most dentists, in considering that rebounding quality that is variously termed elasticity, resiliency or springiness, have in mind elasticity of flexure, and give little if any thought to rotational elasticity. The orthodontists are calling this torsional elasticity, but I have preferred rotational elasticity, because that term has the sanction of the Standard Dictionary.

Observations of the three clasps shown in *figs. 1 to 9* will reveal that they are all so shaped that, when adjusted so as to require a little effort to push them into place, the resistance encountered is due to the spreading effect of the tooth they each have to pass over to reach their seats. This pressure outwards makes operative, as is the case with all wrought clasps, elasticity of flexure from the point where the pressure is applied to the point of fixed attachment of the clasp; and the longer this arm, the less the likelihood of the elasticity of flexure being overtaxed, with the result of not returning perfectly and completely to its previous form. The effect of additional length is noticeable in practice, in the comparison of results with the two forms. The crib clasp shown in *figs. 1 to 5*, being longer from the attachment point to the point where force inducing flexure is applied, holds its form better (other things being equal) than does the modified form of *figs. 6 to 9*. With both these forms rotational elasticity is also utilized, and serves to divide the effects of the deforming influence upon the clasp with the elasticity of flexure, so that the result is to lessen the tendency to over-tax either form of elasticity, because neither one is taxed as much as it would be if the other were not jointly operative with it.

Inspection of the clasps will promptly demonstrate that placing them in their seats results in a torsional stress on all of the perpendicular segments, at a wide angle to the

gold occlusal surface of an already placed lower fixed bridge. If erosions are present, or decay menaces at a point in the buccal surface where it is desired to have a clasp of this type rest, a shallow inlay can readily be placed, and provide adequate protection without risk to the tooth.

There are many variations possible with this clasp, making it the most adaptable of any attachment that I know about. It is easier to form and to fit nicely to a tooth than would be the case if half-round wire were used, and the risk of its inducing enamel decalcification because of an acidulous sordes collection inside the clasp is reduced to a minimum. I do not now recall a case where decay had started under these clasps, for this reason. The possible variations of this combination of clasp and definitely shaped occlusal rest are innumerable, and the ease of repair in case of breakage is an important advantage.

Without sacrifice of any of the enumerated advantages, the saddle may be given any desired form, released from all contact with the teeth or gingival margins, extended over areas where stimulation of the

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segment where the expansion force, due to passing the tooth into the clasp, is applied. It seems evident that the nearer to a right angle the relation of the two segments involved, and the longer the segment subjected to the torsional stress, the greater the participation of rotational elasticity in the maintenance of a state of perfect elasticity in the clasp forms shown.

It is fortunate that this property of our clasp wire can be utilized and that the means of utilizing it, namely, by placing the perpendicular segments deep in the embrasures, coordinates well with the requirements of a clasp design comfortable for its wearer. Technicians, unfamiliar with the problems to be met at the operating chair, argue correctly from this viewpoint that the right position for the bearing of such a clasp on the tooth is usually (some say always) just rootwise to the line of greatest contour. As a matter of mechanics this is correct, so long as we use the clasp form they advocate, which nearly (often entirely) excludes the factor of rotational elasticity. By so locating their clasp, they probably provide for the best frictional contact as an aid for retention and for excellent utilization of elasticity of flexure. This location of the clasp, however, is not a happy one for the patient or operator, because it places it at the point where it is more obtrusive to the tongue of the patient than at any other possible location.

By adopting the clasp forms advocated in this paper, the clasp is placed in its least obtrusive location, and the full utilization of rotational elasticity, which the other form utilizes only to a very minor degree and frequently not at all, adds so much to the efficiency of the clasp as to much more than compensates for slight loss (if there is a loss) in the feature of frictional contact; while elasticity of flexure is increased in proportion to the additional length, the comfort of the patient is markedly conserved, and the dentist is relieved of the problem of convincing the patient that obtrusive wire is not as bad as it seems.

mucosa is desired, and the clasps and lugs so shaped and proportioned as to have the saddle both stable and movable. See Cummer's article (1) for elaboration of this thought. Stability equal, or superior, to that of other bridges is readily obtainable.

I believe that within five years the manufacture of the present-day split bridgework attachments will have become unprofitable because of the cessation of demand for them, and that some form of clasp and lug bridge will be the standard appliance for the profession in partial prosthesis. I also believe that earnest and intensive study of the principles emphasized in this paper, will prove their adaptibility for from 70 to 80 per cent of the partial prosthetic restorations we are called upon to make, and that their use will result greatly to the advantage of our clientele. If this be true, the welfare of the dental profession will also be advanced by such a course. At the present time a reputation for reasonable conservatism is of more value to a professional man, than the financial returns from elaborate bridgework. Such a reputation cannot be built, or conserved, if procedures are advocated and practised that lead to the early incidence of either pulp pathology or pericemental pathology, and too often these are the results of all forms of movable bridgework supported by split attachments engaging in gold inlays.

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DISCUSSION

C. W. Rubsam, D.D.S. (New York City): Whenever I listen to the discussion of a dental paper and the discusser's opinions are unknown to me,

I find it agreeable to have him announce early in his discussion the side of the question which he proposes to defend. This action on a discusser's part is a guide to be used in measuring his later statements and also precludes the danger of his hedging on the issues. With this idea in mind I intend to lay my cards on the table at this point and declare myself unreservedly opposed to fixed bridgework; occasionally in favor of clasp dentures for permanent usage; and in favor of removable bridgework for the great majority of cases in need of prosthetic replacements.

Your essayist stated that only 5 per cent or one in twenty cases is suitable for the use of fixed bridges. I would say that this is a very small minority indeed to bother taking up the cudgels for. If the principles of fixed bridgework are so erroneous in the other nineteen cases that its use is excluded in them, then why go on record in behalf of the exceptional case that has survived these same erroneous principles simply because these principles were reduced to their minimum destructiveness?

In reading the paper, I was brought to a full stop by these two statements closely following one another: "Where careful selection and careful technique has been practiced, followed by many years of successful service of a fixed bridge, accompanied by a continuing sound condition of the supporting abutment sufficient to lead the experienced practitioners of keen perception to anticipate further long terms of service, there is reason for skepticism as to the wisdom of universal condemnation of the fixed appliance and it takes but few such cases to compel review of the evidence on which they have been condemned." . . . . "As the enthusiasm for the fixed bridge began to fade and well balanced practitioners realized how weak a reed they had been leaning upon, the removable bridge became the new pet and conservatism was again forgotten and history repeated itself." You will observe that these views are diametrically opposed to one another. How can we reconcile successful service of a fixed bridge with the metaphorical allusion to leaning upon a weak reed? In the essayist's effort to justify the use of fixed bridgework in what he calls "an exceedingly narrow field of usefulness," he has magnified the importance of these occasional fixed bridges which he has used, out of all proportion to their relative value in the whole restorative field.

But let us confine ourselves to the statement of your essayist that only a very small portion of his cases have been suitable for fixed bridgework. He implies that these were one-tooth cases fixed at one end. I sincerely believe that we are incurring a grave moral hazard by advocating the use of fixed bridgework in any degree whatsoever. We are placing a weapon in the hands of the indifferent and reactionary worker when we say that,

in a limited field, fixed bridgework is permissible. It will not be long before this wavering individual justifies himself in the use of the one-tooth case fixed at both ends, then in the two-tooth case fixed at one end, next the two-tooth case fixed at both ends, and so on down the list.

If I were to defend the small fixed bridge, little damage would be done, for I am little known in the profession and heeded even less. Not so, however, when a man of our essayist's prominence in state and national dental circles puts himself on record in this matter. He is generally recognized and esteemed from coast to coast, and in that proportion he is assuming a graver responsibility in the moral hazard of recommending partial indulgence in an operation which the profession was reluctantly relegating to the archives of past performances.

I have never seen a one-tooth case in which a fixed bridge was placed that could not have been cared for at least equally well by a correct removable bridge. When an abutment is so prepared that by inlay or other device it is enabled to hold a fixed appliance, it certainly needs no radical changes for the insertion of the rationally selected removable attachment. In no other way can we secure the maximum in sanitation about the artificial substitute. By caring for these simple cases with a removable appliance we once and for all detach ourselves from the group of those who delight in defending fixed bridgework of from one to fourteen teeth in extent but who cannot give us a plausible reason against the use of properly made removable bridgework.

This is an issue with clear cut borders that cannot be clouded by circumlocution. Disregarding, for the moment, the quality of mechanical execution in fixed or removable bridgework, the principles underlying the two systems are so widely divergent that they cannot be equally acceptable to the human organism. If you will agree that mobility under mastication is necessary in every living peridental membrane, you are bound to admit that that system of bridgework which comes nearest to providing for this motion is by that attribute to be preferred over any other system. May I be permitted to ask, what pattern in nature has been used as the prototype for the bridge fixed at one end and merely resting in a lug seat at the other? Does that give you individual mobility of the artificial substitute so as to take the strain off the abutment during the act of mastication? Is the fixed pontic capable of as thorough cleansing as the removable substitute? The essayist has gone on record on previous occasions in condemning fixed bridgework on that very score. Why does this broad principle become innocuous when a short fixed bridge is involved? And further, if a saddle under a movable, removable pontic

is able to prevent atrophy of the subjacent tissues by gently stimulating circulatory activity during every masticatory thrust, does not that factor alone lift it above the class of the pontic that rides high above the tissues it should stimulate and merely passes on its occlusal blows intact to the tethered abutment?

Your essayist intimates that he allows for this mobility by fixing the pontic at but one end. Let us see if this is so. One end of his bridge is fixed to a crown or inlay. The other has a lug resting in a well defined, rectangular lug seat. Mobility in one direction is permitted, namely away from the floor of the lug seat, but that does not happen to be one of the movements required during mastication.

I cannot pass on without challenging the term "semi-fixation." It is contradictory because it may mean one of two opposing things. One is that the bridge is not fixed in relation to one of the abutments and the second is made possible by a single fixed abutment, being able to supply a certain degree of mobility to the artificial substitute. Therefore, a case of this type is fixed in relation to its abutment but movable in relation to its seat support. Yet neither factor permits the use of the term "semi-fixation" in a correct sense, for a thing cannot be "half fixed" which is what "semi-fixation" means. It is fixed or it is not, depending on which feature of it you are visualizing at the moment. We have the familiar analogy in the expression "open occlusion" with its contradictory elements.

In the field of the clasp denture, we are using a compromise between the fixed type and the removable type. I use the clasp denture freely as a temporary device pending completion of tissue change following surgical procedures. But in permanent work, I have little use for it except in the few cases in which the placement of removable bridgework would necessitate cutting into teeth with hitherto unbroken enamel. If fillings of even slight proportions are present in the abutments, I feel justified in advising removable bridgework. That the economics of this phase of our work does not always permit the insertion of removable bridgework must not be taken as an argument that clasp dentures are just as satisfactory. This is supplying an excuse and not reason in the controversy.

In the case of the abutment with unbroken enamel, I am prepared to use a clasp until the inherent short-comings of clasp dentures make their appearance, and after that I am ready to advise conversion of the space to the removable type of bridgework. But let us remember that numerically, only a small proportion of cases for restoration present teeth unblemished by operative interference.

The clasp seems objectionable on several grounds. If it is loose enough not to do injury to the teeth by mechanical friction, it is too loose to be of service in maintaining the appliance in its correct position. If the clasp is tight enough to limit the mobility of the denture, it is tight enough to produce mechanical wear on the enamel in the absence of a lubricant. Saliva has never had that property attributed to it and, in lieu of an artficial lubricant, is it not rational to assume that two hard surfaces will produce mutual wear? This wear comes in part upon insertion and removal of the denture, but principally upon the movement imparted during masticatory function. If the clasp denture is so firm that it cannot move on its abutments under masticatory stress it automatically falls into the classification of fixed bridgework even tho it lacks some of the earmarks of the latter. Hence the condition of rigidity must be excluded from the formula of a clasp denture.

Another factor militating against the choice of clasp dentures over removable bridgework is the fact that mastication produces not only a lateral thrust on the abutment thru its opposing tooth but the lateral thrust sustained by the pontics must also be borne by the abutments. In removable bridge attachments inserted into inlays, the side of the box against which the lateral thrust comes, is close to the long axis of the tooth, thus reducing the multiplication of force due to leverage. In clasp dentures, however, the lateral thrust on the tooth is imparted at the extreme outer portion of the tooth surface, buccally or lingually, giving a distance from the long axis of the tooth two to three times as great as the corresponding lever arm in a removable bridge attachment. The other vital tho easily overlooked differences, in this matter of relative leverage indices, is that a lateral thrust on a bridge attachment tends to expend its force by driving the tooth into its socket, while the clasp exerts its force in a way to tend to lift the tooth out of its socket. Nature has endowed the peridental membrane with more facility in overcoming depressive tooth force than extrusive tooth force when carried beyond limits normal to an individual tooth. Whenever a filling presents in a prospective abutment tooth, I consider it the proper procedure to remove the filling and prepare an inlay cavity for a bridge attachment. Capable minds working on the problems of furnishing strength without bulk in inlay attachments have succeeded in supplying a product that neither necessitates endangering the pulp nor giving overplus contour to inlays, which your essayist brought up as his only objection to removable bridgework.

The part of the bar attachment encircled by the box was not the part of inherent structural weakness and hence does not need to be large, but

the part of the bar extending from the truss to the inlay was invariably the part to break. The new type of attachment combined with proper soldering has eliminated the weak spot in the technique. The only remaining obstacle to general usage of removable bridgework is the economic factor. I have no solution for it but that does not excuse our confusing the issue by assuming that clasp dentures are a perfect substitute for a correctly designed and perfectly executed removable bridge.

Do we consider as we glance back over the years, that the man who abandoned amalgam for foil fillings, and finally foil fillings for the inlay, was an extremist? Decidedly not. And still today many believe that the man who has passed from fixed bridgework to clasp dentures and then from clasp dentures to removable bridgework is an extremist. I daresay the well trained technician of the future will have a much higher percentage of success with the advanced types of removable bridgework than was ever dreamed of by the fixed bridgeworkers.

In conclusion I wish to say that it has given me keen pleasure to enjoy the privilege of coming before your organization as a discusser. While I may seem to have had the temerity to differ with the essayist of the evening on some points, I wish to pay my personal tribute to Dr. Gillett at a time when he is laying down the mantle of active professional life. There is no doubt in my mind that his individual skill and his broad vision have done much to keep the Ship of Dentistry on an even keel thru his years of untiring service in the ranks of the profession. If I could be assured that, in a corresponding span of practice, I might contribute one-half as much of value to the profession as has Dr. Gillett, I would feel that my career had not been in vain. While this may mark the cessation of his direct ministration to his clientele, I sincerely trust that he may be accorded many years of happy living in which his confreres will benefit from the accumulated experience he has acquired during the years spent as an earnest student and teacher. A man's crowning glory as the years go by is his handing on to the younger men the refined judgment of past events gained by painstaking observation, comparison, and reflection. Each new generation in a profession can only hope to attain higher levels by standing on the foundation prepared by the best men of preceding days.

F. T. Van Woert, M.D.S. (New York City): I congratulate Dr. Gillett upon his able presentation of this most important subject and on his courage in opposing the generally accepted methods of the current period.

We have been concentrating upon methods to relieve our patients of all devices which even simulate the so-called partial plate, in many in-

stances (more than we would care to acknowledge) at a great sacrifice to the patient and to the deep humiliation of the operator. If not properly designed and constructed, there is probably no type of partial restoration that proves so disastrous in its results as that which depends upon attachments into inlays and, in many cases, crowns. If we were to be impartial and carefully select for them only the cases where the patient's welfare plainly dictates their use, I am sure the bridges with anchorage solely in inlays would be largely in the minority. I am convinced that the type of fixture so beautifully illustrated this evening has a great field of practicability for most of our cases, and is far preferable to those dependent entirely on inlays for support. As an evidence of my convictions in this direction, I present the following slides illustrating some of the cases in our private practice.

The first is that of a restoration of the four superior incisors. This case replaces a fixed bridge of two teeth which did service less than three years—the present one having been in the mouth at least ten years, and still promising many years of service to the patient. It was designed by my son, and it proved so satisfactory that many of our succeeding cases have been designed upon the same lines, with the exception that the more recent ones have been equipped with the Kayle clasp.

The introduction of this attachment has made possible what seemed impossible in the past, and helps to establish mobility in the fixture without interfering with the normal function of the natural teeth involved. These clasps, whether of wire or flat metal, together with suitable occlusal rests, form one of the most satisfactory partial-denture restorations that it has been my pleasure to furnish, and they have received liberal commendation from my patients for the great comfort enjoyed in their use.

As you will note, some of the cases represented in the following slides are very similar to those designed for removable bridgework. I am strongly of the opinion that we have been extreme in our desire to eliminate clasps and like attachments. While it is true in some cases they are more or less disfiguring, it becomes a question of which is the lesser evil. Is it good practice to supply something a little more artistic for a short period, and later have to resort to a device supported by clasps, or else lose all the teeth, when this risk might, in many cases, have been eliminated by the adoption in the first instance of some one of the devices described by the essayist or such as I show upon the screen.

I regret exceedingly that these slides which are colored photographs, cannot be reproduced. Hence, it will be difficult to describe them in print.

I sincerely hope that the members present will give this matter their careful consideration, as I believe it will be the means of saving many heartaches in the future both for the patient and operator.

F. R. Getz, D.D.S. (New York City): Each succeeding discusser of a paper has an additional burden placed upon him if he wishes to take account of all the points brought out by the discussers as well as by the essayist. I will make one or two observations on what my predecessors have said, and then I shall go on to what I have found in Dr. Gillett's paper.

I have found it is an extremely difficult thing to discuss technique in prosthesis in a general way. You can split hairs until you get microscopic fragments. The only way to discuss cases and systems of technique is to get the case, study the mouth, make models, study them and then apply your thought to it, always with the question, "What method, principle, or combination of them will most likely serve to lengthen the life and service of all the teeth remaining in the mouths."

I want to call your attention to the fact that there is absolutely nothing permissible except removable bridgework in every one of the essayists cases. Will you tell me, if we judge from the illustrations, how you could have used anything like the inside contour manufactured attachment in the case which Dr. Gillett first showed? There is nothing that I know of but the clasp type of attachment that would have been so conservative, and I would have used it there also. To be fair to both sides, it is perfectly absurd for any advocate of any system to assume that anyone system in itself is adaptable to every state or set of conditions. It is lamentable that there are so many avoidable conditions for the prosthetician to handle, from the state, where there is only one tooth missing to that where there is but one tooth present, with all the various intermediate states between those two. He must handle each case individually, give it ample thought, and take the best from the various systems in planning its restoration. It should not be passed on to the laboratory. That has produced much of the kind of dentistry which Dr. Hunter condemned. I hope the time will come when each office, which claims to be a first class office, will have its own laboratory man right under the dentist for whom the work is being done, so that its progress can be watched and guided and corrected until it comes to the point of a finished product as good as can practically be made.

I want to say something about what Dr. Van Woert stated, and also about one of the models he showed. I believe it was a piece carrying all

of the teeth in the anterior part of the mouth and anchored to the two molars, by what on the picture, appears to be cast clasps. Not favoring them generally, I think in that case the cast clasp was an advantage.

Dr. Van Woert: That was a flat clasp. It was not a cast clasp.

Dr. Getz: It is in effect practically a cast clasp, and on the picture, appeared to be so.

The other point which Dr. Van Woert brought out was that we are prone to exaggeration, and that we over educate our patients on the importance of the esthetic side. That is absolutely true. For example, in cases where certain types of crowns are not indicated I frequently put the question to my patient in this way: "Would you rather have a little band showing after a year or two, or lose the entire tooth?"

Dr. Gillett's paper is full of interest for me; it should be for every dentist who makes prosthetic restorations of any kind. I hope it will come to the attention of some of the followers of the ready-made attachment enthusiasts. It indicates consistent conservatism and sound common sense, which latter seems to be so conspicuously absent in many things that dentists do. I shall confine myself to the main points of what Dr. Gillett has told you.

It is true that a large proportion of the men in our profession have been too ready *not to try* a new thing, *but to accept it* as a principle and part of good practice. This is not saying that some new additions to our principles and technique are not good, but the harm comes where the student or follower does not or cannot grasp the essentials that are good, and carry them out faithfully. Or he may lack the sense of comparative values which would enable him to see and utilize that which is good and leave that of doubtful value strictly alone, or take it on trial only, without pinning his faith to it as so many have done in some principles of bridgework advocated so insistently for some years past.

Dr. Gillett thinks that it is "because our procedures are not well standardized, and because of the greater opportunity for the introduction of mechanical devices in our work." I do not interpret that as the sign of regret on Dr. Gillett's part that we do not have a standardization of technique in bridgework. Certainly it would be a sadder time for patients if some of the patented bridge attachments, mentioned with standardization arguments, were accepted officially as standards of good dental practice. I am glad to know that Dr. Gillett has come again to see that the fixed bridge is both serviceable and conservative and can be made clean. Of course neither he nor I, nor any of you, are thinking of the things that all of us have seen in the past—straight-side thimble-crown abutments,

projecting edges, and bridges set over cavities from which not so much as the softened dentine was removed. Some of those bridges are being made today. If you don't believe it, go to a supply-house tooth counter and notice some of the models for bridgework that come in for tooth selection. They look like gobs of plaster with ready-made shell crowns thrown at them. Where do they come from?

But to return to what Dr. Gillett has in mind: the short fixed bridges advisedly used are good practice, and will continue to be in the very nature of conditions for and the circumstances under which prosthetic restorations are made and will continue to be made. I have never abandoned the fixed bridge for certain cases, even though I have made hundreds of removable or detachable bridges of different types. The permanently attached or so-called fixed bridge has received such unmerciful condemnation from some who know something about them, and from others who do not, and also from some who have something to sell, that it is a satisfaction to have a man of years of experience and observation come forward and say that it is still good. What the profession needs is not so much system, technique, or standardization, as more men of individual good judgment to study and diagnose their cases and select restorations that would in all probability give best results, and then the rest is covered by what Dr. Gillett says: "No dentist may venture to say what a decade will bring to his seemingly healthy patient, and I do not doubt that any one of the cases that I speak of as a success can quickly be turned into a failure by the incidence of any one of several organic diseases."

The same may be said of all prosthetic work, but that does not keep us from recognizing that, other things being equal, the averages of service, satisfaction and economy are higher and better with the use of some types of attachments for removable bridges than they are with others. This is not saying that there are not good features in each. But when the question is narrowed down to the selection of an attachment, that one which requires little or no modification of a normal or almost normal tooth as an abutment should be chosen. The answer is simple and so is the attachment. Of course, there are many cases where something other than a clasp must be used, but if you stop to consider for a moment you will see that there are two general classes of bridge attachments, those that depend for anchorage within the tooth-crown contour or enlarged contour and those that give retention in contact with the outside surface of the tooth. To the latter belong the clasp and lug attachments of various types. These various types have a wide range of adaptability for retention of regulating appliances and bridges, and in bar and saddle prosthesis.

Dr. Gillett is thinking of perfectly sound teeth, or those nearly so, to be used as abutments, so, if we wish to employ the type of clasp that is most adaptable, strong for its size, and likely to have the least effect upon the tooth, we are at once limited to the slender clasp made of light but strong metal. Dr. Gillett has found this in the loop clasp made of a light gauge of round, elastic wire.

I found satisfaction in using the half-round elastic or clasp wire, and read a paper on "the use of the clasp and lug as attachments for short bridges and partial dentures, and methods of making lugs," before the Union Meeting of the Fifth, Sixth, Seventh, and Eighth District Dental Societies of the State of New York, at Syracuse, on November 25, 1915. That was published in the *Dental Cosmos* for May, 1916.

I have never tried a loop clasp, mainly because I found the half-round wire or the narrow clasp cut from flat sheet metal to meet conditions satisfactorily, and I am one of those who, having found a good thing, just quietly keep on using it. I am very favorably impressed with the loop clasp as shown by Dr. Gillett, and can see that its directional range of movements and elastic limits are more varied than those allowed by the half-round wire. It has been tested and proven by Dr. Gillett, and I am willing to take without question his report of his success with it. The motive is right, the principle is right, and it is comparatively easily made. Furthermore the principle of the clasp attachment is not patented; and never will be. It would not make any difference if it were, because the dental profession is concerned with the general health of the patient through his mouth, and in keeping or restoring his teeth and arches to a normal state of functioning. Whether he is invited into consultation or makes his own diagnosis, the decision for a certain procedure is in the nature of a prescription or course of treatment, in which he prepares and uses whatever method, means, principle, or appliance that in his judgment is called for by the conditions of the case (I am not now speaking of instruments or tools). In that respect he is in exactly the same relation to his patient as the general physician, in prescribing and combining simple drugs and known remedies.

I have tried and found unsatisfactory a number of patented attachments, some for use within the contour of the tooth and some without. For me they have proven unsatisfactory, for the reasons stated by Dr. Gillett, but it is a noteworthy fact that the attachments that have stood the longest test, so far as my knowledge of them goes, the ones that have proven most conservative and satisfactory where indicated, like the Bonwill clasp principle and the Peeso split-pin and tube, are not patented. These men were thinking of their patients and their work.

Pulp removal is always to be avoided where possible, but there are conditions where the retention of a pulp is less conservative and less far sighted than its removal. However, that is a question that is relative and in fairness to every view could be discussed in an interesting way upon a set of models of an actual case with its accompanying conditions. To place large or comparatively large inlays, with attachment seats within their contour, near pulps does not avoid pulp removal, but invites it.

I do not wish to extend this discussion to great length but Dr. Gillett mentioned the fact that the partial denture had fallen into disrepute in the profession. That is because comparatively few men gave the conditions a second thought beyond putting something there to fill the spaces. Stability, function, comfort, efficiency, durability, adaptability to future conditions, and economy for both dentist and patient concerned, seem to have received little study or consideration.

If in the term partial denture, Dr. Gillett and I are thinking of the same thing, I agree with him, when he says, "intelligently used, and with inclusion of abutment rests, it can be made of greater service to some people than any of the types of bridges we know of now." I am thinking of an appliance with small or large saddles, replacing teeth on both sides or in different areas of the same arch above or below, and the saddles joined by palatal or sub-lingual bars. I have named it Bar-and-Saddle Prosthesis, and there are few places where I would not rather put in such an appliance than to make separate bridges for both sides of the mouth.

Two general advantages that Dr. Gillett did not mention arise from the fact that it makes only one piece for the patient to handle; and the abutment teeth and anchorages strengthen and support each other in mastication. This is particularly so in cases of middle age and later, where the upper bicuspids and molars have a tendency to lean bucally and to spread.

There seems to be a tendency on the part of many, advocating certain ideas of pathology, or of particular systems or of special technique, to ignore the changes in the gum tissues and alveolar structure that naturally come about as the years go by. You may say that some alveolar recession is due to malocclusion or some other cause, but in many cases it is only change consequent upon age. In these cases the teeth may or may not have a tendency to loosen. It is a point to which I give considerable attention, endeavoring to counteract it by the use of a suitable attachment, with the palatal or sublingual bar type of appliance designed for the particular case.

I am showing you no slides because I believe that too many pictures

leave only a blur of variety in the spectators mind, and where principles or technique are concerned, as in the paper of this evening, you get most from a few pictures clean cut and well remembered.

Dr. Gillett (*in conclusion*): I shall be very brief in closing. I still feel that I am correct. Nothing that has been said has modified my judgment concerning the very great value of the clasp with the smallest possible contact with the tooth, namely, the round-wire clasp. That is about the only exception I would take to Dr. Getz's position. I have read his paper. It is referred to in the bibliography with my paper. He makes his lug and lug seat very much as I do, and his clasp differs only in the use of half round instead of round wire, and that means a contact with a larger area of the tooth, which I consider unnecessary and more of a menace.

The same thing applies—and is about the only exception I take in principle—to what Dr. Van Woert showed us. It has been a pleasure to see his beautiful slides, and I am very glad to have the further application of the principles made clear in that way.

I want to speak most emphatically concerning the point Dr. Van Woert made: that the first thought in our minds should be service. What can we do for the patient, and in what way can we do it best?

Dr. Rubsam and I do not understand each other. He has not understood my paper, in spite of having it in front of him; and I certainly do not understand some things he said about it. I radically disagree with some of his points of view. I would reverse what he says about the relations of the removable bridge and the partial-denture bridge. I consider the removable bridge rather an imperfect substitute for the partial denture bridge.

I do not grasp at all his viewpoint concerning the different stresses. It seems to me he has missed my meaning; or, perhaps, I had better take the responsibility and say I have failed to make my meaning clear. I realize, from his discussion, that I gave too much attention to the fixed bridge. It has resulted in his assuming that I was broadly advocating the fixed bridge, which I am not. Suitable cases for fixed bridges are rare but I believe it has been demonstrated that occasionally the small fixed bridge or preferably one fixed at one end only can be safely used.

I thank you for your attention and appreciate the courtesy of those who have discussed the paper.

PREVENTIVE DENTISTRY: PERIOD OF DECIDUOUS DENTITION DURING TRANSITION TO PERMANENT DENTITION[1]

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The modern dentist is concerning himself more and more every day with the prevention of disease and deformity; and the time is rapidly approaching when the term "preventive dentistry" will be used exclusively to indicate dentistry for children. Webster defines prevention as "a hindering by previous action; an act of caution." If this is correct, then surely preventive dentistry is such in name only, where it does not include dentistry for children; for at what other period during human life can so many destructive diseases be hindered or prevented? When is there a time that the body responds so quickly and easily to preventive measures as it does in childhood? At no other time can there be a wider or more effective application of the principles of preventive practice; for it is only during these childhood years that defects of development can be successfully dealt with, and during this time occur the greatest number of those diseases which so largely predetermine the deformities of later years. We must realize these facts if our profession is to hold its rightful place in the vanguard of the healing arts; for the laity are rapidly becoming educated to the fact that an ounce of dental prevention is worth much more than a pound of cure, and they are beginning to demand some things which the profession as a whole is not prepared to deliver; such as careful, conscientious work on the deciduous and permanent teeth of children.

In the past, little or nothing has been done for the child's dental welfare. Modern books on dentistry show hundreds of pages devoted to methods of replacement of lost tooth structure, but one

[1] Read at a meeting of the First District Dental Society of the State of New York, at the New York Academy of Medicine, November 6, 1922.

will seek in vain for more than a few paragraphs dealing with children's dentistry; and yet all close students of dentistry will admit that a broken down, abscessed, deciduous dentition will greatly disturb the growth of a normal, healthy, permanent dentition.

FIG. 1.

FIG. 2.

FIG. 1. GIRL WITH NORMAL DECIDUOUS TEETH
See corresponding model, *fig. 3.* (Age, 11 years)
FIG. 2. GIRL WITH DECAYED DECIDUOUS TEETH
See corresponding model, *fig. 4.* (Age, 11 years)

Many dentists seem to regard the children in their practice as a sort of necessary evil and treat them only because they belong to the families of their adult patients. They do not see in the child the possibilities and far-reaching results of saving those deciduous molars and of correct prophylactic treatment and tooth-brush drill. They

overlook the fact that a child will listen to and heed the advice of a stranger when he will many times ignore the urging of his parents. But the greatest oversight of all is the negligence of the dentist in not taking the opportunity to educate the parents as to why and how their children's teeth should be cared for. Most parents are extremely ignorant regarding this subject, laboring under the prevalent delusion that as long as the child has another set of teeth

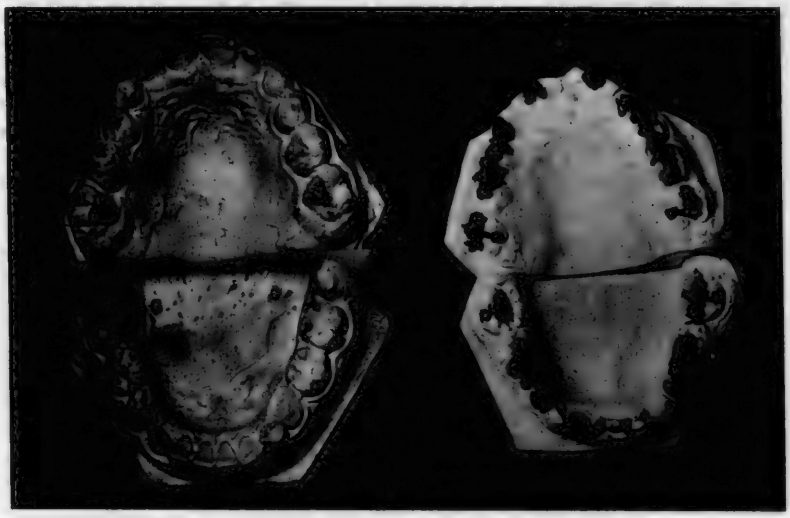

FIG. 3. FIG. 4.

FIG. 3. MODEL OF TEETH OF GIRL (FIG. 1) WITH NORMAL DECIDUOUS TEETH
FIG. 4. MODEL OF TEETH OF GIRL (FIG. 2) WITH DECAYED DECIDUOUS TEETH

coming, why bother about having the first teeth cared for. Those who are engaged in children's work, either pedodontia or orthodontia, will bear me out in the statement that these same parents will eagerly absorb any information which the dentist may give. Parents are actually hungry for this knowledge and often remark: "If I had only known this before, I might have saved little Johnny or Mary all this suffering."

I wish to show you slides of the models of the teeth of two little girls in one of our public schools. They are of the same age, the

same height, and are attending the same school. These cases are typical, one of true preventive dentistry and the other of neglected dentistry.

Fig. 1. This first little girl was presented to Dentist Number One at the age of two years, with deciduous teeth that were perfect in every way except for the green stain on the gingival third of each tooth; and it was this green stain which had brought the anxious mother to the dentist. He carefully examined her mouth, proceeded to remove the stain and polish the roughened enamel, at the same time giving a short talk on mouth hygiene and care of children's teeth to the interested mother, advising her that this appointment was merely a beginning of his constant supervision over the baby's mouth until such time as all the permanent teeth were in place. During the succeeding nine years he saw this little mouth every three months, at which times a thorough examination, prophylactic treatment, and tooth-brush drill were given. Three or four times small cavities were discovered and promptly filled, causing little or no pain to the child and comparatively little worry or expense to the parents. The child developed a strong, robust body and a keen, active mind; and stood near the head of all her classes in school. During these years she learned to love her dentist and anxiously to await her next appointment with him, rather than seek to avoid it. She has now grown into beautiful young girlhood and would no more think of neglecting her mouth hygiene than she would the hygiene of her body.

Consider now the second picture: *Fig. 2.* This little girl was first presented to Dentist Number Two at the age of two and one-half years, at which time one cavity was apparent in a first deciduous molar and there was much green stain on the gingival third of her teeth. The advice given to this mother and child was as follows: "These are only baby teeth which she will soon lose; consequently there is no object in filling them. Besides, she is too nervous to work for." And with this he dismissed the case, sending that mother away satisfied that she had done all that was necessary towards saving those deciduous teeth, for had she not consulted a dentist who supposedly knew his business?

What was the result? The models (*fig. 4*) answer by showing the

condition at eleven years of age when every deciduous tooth was affected by caries, three were abscessed with fistulous openings discharging pus into the oral cavity, and the four first permanent molars were decayed almost to their pulps. The teeth were covered with filth, for she seldom used a tooth brush. She could not masticate her food, being able only to punch holes in it; and as a result, she ignored the hard crusty foods she should have eaten and asked for the soft foods which required no mastication. She was under-nourished, anemic; her weight was thirteen pounds less than that of her normally developing little friend who had consulted Dentist Number One. Her adenoid tissues and tonsils were enlarged and she was a chronic mouth-breather. She had lost all interest in work or play, was listless and indifferent. Through frequent attacks of illness she had become not only a great cause of worry to her parents but a burden to the taxpayer; for she was two grades behind in her school work and had become an annual "repeater."

Who was to blame for this child's condition? Had not these girls an equal start in life, with home conditions practically the same? Yet because the second had consulted a dentist who did not believe in true preventive dentistry, she was condemned to spend the years of her childhood suffering from the results of a broken down, abscessed dentition. Is this justice to the child? Is this true dentistry? Can the total result of the years we have spent in the study of dentistry be summed up in our ability to replace with great precision lost tooth structure, or will the dentist of the future seek a higher ideal and prevent the loss of this tooth structure and its consequent pain and ill health. A few years ago Doctor Mayo said: "The next great step in preventive medicine must come from the dentist." Unless we practice true preventive dentistry for children, can we ever take that step?

Surely, to the mind of an intelligent layman, accustomed in his own business to close deductive reasoning, this attitude of indifference on the part of our profession toward children's teeth must appear very irrational, and it certainly gives just grounds for the charge that we would rather replace a lost tooth in the adult than try to prevent that loss by caring for the child.

Dr. Otto King in a recent article has most truly said: "The true

physician and dentist of the future will not be engaged in doctoring or repairing. His business will be to get to the fundamental causes of disease and then educate the public to adopt preventive measures. When the program of reparative measures is replaced by one of prevention, the ax will be laid at the root of the tree." Even ten minutes each day spent in the education of some parent will be bread upon the waters of dentistry and will be your greatest contribution to the cause of preventive dentistry.

There is apparent in some dentists an ingrained fear or dislike for operating on children which amounts almost to an obsession. This type of man should never attempt to work on children, for it is a fact that he often does more harm than good by arousing in the child's mind an unwarranted fear of dental operations that remains throughout life and often causes him to endure excruciating pain and possibly the loss of all his teeth rather than consult a dentist. There is another type of dentist who avoids operations on children because he dislikes to cause them even necessary pain. To this man I would say, "Perform all the operations on children possible, for you have the natural sympathy which is one of the first things the child unconsciously seeks in the operator, and in the greater association with children you will overcome your fear of causing pain, secure in the knowledge that this little pain of the present operation will eventually prevent a greater suffering."

In treating children it should always be borne in mind that a nervous condition of the operator is immediately noticed by the child, and his nervousness and fear of what is to come will be increased accordingly. To the child mind these first impressions are lasting ones, consequently, if possible, let his first visit to you be one which he will remember with pleasure rather than with fear and trembling. When working for children it is very necessary that your office, your assistant, and yourself be as immaculate as possible; for you will find that they are strongly impressed by outward appearances and often, in their frank open way, will discuss with their parents the impressions which you and your office have made upon them.

I have found it an excellent plan to learn the child's first name before he is ushered into the operating room, and then, when he does appear, to use it in some cheerful form of greeting. After he is placed

in the chair, explain to him every move you make, for he will be watching you closely, in constant fear that you will unpleasantly surprise him. Be absolutely truthful in your statements to him, remembering that you are on trial and that the future success of all your work on that child depends upon your gaining his confidence; and once you have obtained this faith, be sure that you do not abuse it. If the tooth has been aching, it is necessary to give relief, and with this relief a real confidence in your ability is aroused.

An accurate record of the child's mouth conditions as well as of general health must be secured; therefore it is advisable to make a thorough examination at the first or second visit, carefully recording all cavities, rough enamel surfaces, superficial decay, variations from normal in occlusion, and especially all abscessed deciduous teeth. At his first visit should be noted his exact age, height, weight, condition of health; whether he is under a physician's care at that time and, if so, the physician's name; whether he has had adenoids or tonsils removed; the diseases of childhood that he has suffered; and whether he has ever suffered from malnutrition. These points will all be found useful in determining the degree of susceptibility to decay, which in turn should determine the frequency of recall appointments for examinations and prophylaxis, varying in frequency from once a month in extremely susceptible cases to once every three months where the degree of susceptibility is low and home care good. It is, I believe, the consensus of opinion of those engaged in children's dentistry that the most important factor in the success of all pedodontic practice is the constant supervision which is made possible by these recall appointments.

And now supposing that we have a record chart completed, let us examine it and see what we shall find. I will take a typical neglected case, such as you all are familiar with. The child is extremely nervous and afraid of being hurt. It is his first visit to the dentist and he has heard his parents discuss the agonies which they have endured in the dental chair, forgetting the old adage that "small pitchers have large ears," and never dreaming that the small boy is taking it all in and storing it away in his mind until the day when he himself is placed in the dental chair. Then it all comes back with a rush. He immediately associates dentists with pain and conducts

himself accordingly. Age is given as six years, nine months. He is four pounds under weight, of normal height, and shows little or no interest in work or play. He is developing an extreme mal-occlusion, and has rarely used a tooth brush. Has had adenoids and tonsils removed with some resulting improvement. Had measles with a high temperature, at the age of three years. Was a bottle baby, his diet for many months consisting mainly of condensed milk. Both mandibular first permanent molars show large bucco-occlusal cavities with deep decay, sensitive to heat and cold. All mandibular deciduous molars show large cavities and two of these present abscesses with fistulous openings on gums. Mandibular deciduous anterior teeth are good, although covered with stain. The teeth in the maxillary arch are in just as bad, if not a worse, condition. The anterior teeth have cavities on approximal surfaces. You have all had these cases and many a time your courage failed at the thought of starting treatment. Many of us, I am afraid, have sadly neglected them, doing only such work as was necessary in order to dismiss the child, and praying that some kind Providence would prevent the other teeth from aching and the consequent return of the little patient.

In placing fillings in deciduous teeth we frequently face difficult problems; for by the time these mouths are presented to the dentist the cavities are generally in an advanced stage of decay, and tax to the utmost our patience and ingenuity in their repair, for the following reasons:

(a) We must use a cavity preparation which will afford the maximum of strength and retention with the minimum of cutting.

(b) We cannot in a great majority of these teeth remove all decay, for in so doing we would expose the pulp.

(c) Decay should not be left in the cavity unsterilized, so it must be sterilized before placing the filling; or some type of filling material may be used which is in itself an inhibitor of the spread of decay.

(d) We must use a filling material having the greatest degree of adhesiveness so that it will be retained with the least amount of cutting in cavity preparation.

(e) It is also desirable that our filling material should hold its contour and shape under stress of mastication so that our contacts will not be destroyed.

But of these last two qualities, that of adhesiveness is the more necessary in children's dentistry.

(f) We must so conduct our work that the maximum amount may be accomplished in the shortest space of time.

(g) And most important, frequent inspection is imperative for continued good results.

For convenience these problems will be considered separately.

The cavity preparation (a) in the deciduous molars of our present typical case will be controlled by two things: the amount of solid tooth structure remaining and the type of filling used, whether amalgam or cement. If the metal is used it is necessary that we obtain a good dove-tail preparation and gingival seat; otherwise, our filling will loosen under stress of mastication and become crowded into the interproximal space. This automatically eliminates amalgam in our present case as it does in many of those proximal deciduous cavities, for there is not enough solid tooth structure left to meet this requirement. If we use a good cement, less retention is necessary, and many times it may be used upon a perfectly flat surface with no retention at all.

Problems (b) and (c) are now presented, for we have in the bottom of our cavities decayed dentine which must be sterilized. After observing results in some eight hundred cases extending over a period of three years in the Dental Clinic of the Denver Public Schools, I do not hesitate to state that the ammoniacal silver nitrate treatment, as developed by Dr. Percy Howe and used extensively at Forsythe Infirmary, is far superior to anything of the kind which has ever been given to the dental profession. This solution penetrates and hardens all decay, sealing the minute tubulii with precipitated silver, giving a firm sterile base on which to build the filling; and, most desirable of all, it leaves the natural roof over the pulp, which is far superior to any pulp capping ever devised.

Problem (d), regarding filling materials, is a problem indeed, and there is room for great improvement in those at present obtainable. It is very advisable to use a material which has enough copper content to inhibit decay, and this means that it must be either copper amalgam or copper cement. In my experience the cement is more effective, for it is easy to manipulate, sets quickly, requires very little retention or cutting, and, above all, "stays put." The only

objection to it is that it will wash out, but this objection may be eliminated through frequent inspection and refilling at the proper time.

In answering problem (f), I would say that the maximum amount of work must be accomplished in the minimum of time; for, after the first fifteen minutes in the chair, a child becomes fidgety and hard to work upon. Therefore, we must waste no time after he is placed; everything should be ready and accessible. Every move should count and yet the appearance of haste must be avoided. If you know that a part of the operation will cause him pain, if possible defer that operation until all other work is completed. This especially applies to extractions; otherwise the work is rendered much more difficult by the child's fear that you will again cause pain.

The last and most important requirement is frequent inspection of our work (g), for no matter how careful we have been in placing the fillings, they will fail much easier than those in permanent teeth. No matter how painstaking we are in the matter of sterilizing or in pulp capping, we must remember that the deciduous tooth pulp is much larger proportionately than the permanent tooth pulp and is therefore more susceptible to injury and death; and the only means of preventing further damage and pain is frequent inspection and early repair. This should be carefully explained to the parent at the time of operation.

This is a rather formidable list of requirements and one which is not always possible to follow, for all children's dentistry is governed by the actions of the individual child; but it is certainly worth the effort, if we can thereby reasonably assure the child of a perfect masticating apparatus, a normal face contour, good health, and, above all, relief from pain.

Many years must elapse before there are enough pedodontists to care for the children in our big cities. Therefore, it would seem that the only way for the dental profession to discharge its duty to children is for every man to assume his share of responsibility for the education of the parents in his own practice, and for those men who are at all able to handle children to do more and more children's work. It is sometimes difficult work, calling for the patience of a Job and the wisdom of a Solomon, but if you will make a consci-

entious effort to do your very best work on every child you are asked to treat, you will be repaid with something far more valuable than gold—the smiles and confidence of little children.

SUMMARY

(1) True preventive dentistry can be practiced only during childhood.

(2) Little or nothing has been done in the past for the child's dental welfare. Modern books on dentistry devote very little space of pedodontia.

(3) The majority of parents are extremely ignorant regarding their children's teeth.

(4) A vicious circle of digestive disturbance, impaired function, lowered resistance, and ill health results from the dental neglect of children.

(5) A dentist who has a dislike for children should never attempt to do children's work.

(6) Success in children's work is in direct proportion to the degree of confidence gained.

(7) All mouth and health conditions of the child should be accurately recorded.

(8) The important problems in filling deciduous teeth are cavity preparation, filling materials, dentine sterilization, speed in operation and frequent inspection.

(9) All children's dentistry is governed by the actions of the individual child.

(10) Every dentist should educate the parents with whom he comes in contact, and more men should specialize in pedodontia.

SUPPLEMENTARY COMMENT AND ILLUSTRATIONS

I have two cases which illustrate very well some points I wanted to bring out in my paper, showing effects of infection from broken-down and abscessed deciduous molar teeth. One child was in an extremely weak and run down condition, and rallied immediately after the extraction and treatment of such teeth, showing the very great necessity for preventive dentistry at that age. Another little

FIG. 5. MODEL OF NEGLECTED INFECTED DECIDUOUS TEETH; DEATH FROM FOCAL INFECTION

lad came from Wyoming to Denver. His father had taken him to a dentist to have eight deciduous molars cared for—four had putrescent pulps (*fig. 5*). The boy was running a high temperature, and the parents naturally were very much worried. The dentist said they were baby teeth and could not possibly be the cause of the trouble. The second day after he came to Denver, the boy developed a slight cold and was taken to a hospital, where it was found necessary to remove his tonsils; he died the day after. The surgeon who performed the operation said that nothing but the infection from those deciduous roots caused the boy's death. You have all seen such cases. They demonstrate that we have not paid the attention we should to those conditions.

Figure 6 shows broken-down, abscessed deciduous teeth, that are causing both imperfect absorption of roots, and malocclusion. *Figure 7* shows the first permanent molars decayed and abscessed in a mouth containing many diseased deciduous teeth.

Mothers should have pointed out to them the fact that the sixth-year molar comes in behind the last baby tooth. The number of parents who believe that this is a deciduous tooth is simply astounding. They think it need not be cared for.

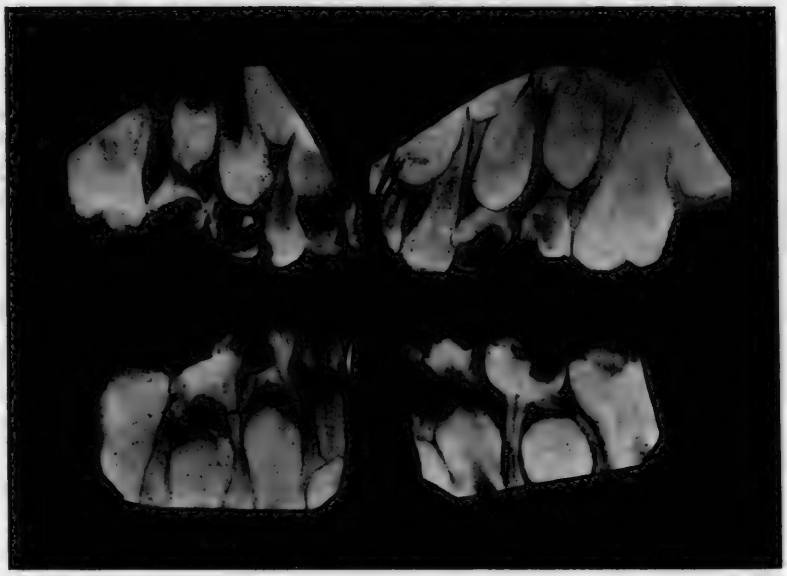

FIG. 6. RADIOGRAM OF BROKEN-DOWN, ABSCESSED, DECIDUOUS TEETH THAT WERE CAUSING BOTH IMPERFECT ABSORPTION OF ROOTS AND MALOCCLUSION

FIG. 7. RADIOGRAM SHOWING THE FIRST PERMANENT MOLARS DECAYED AND ABSCESSED IN A MOUTH CONTAINING MANY DISEASED DECIDUOUS TEETH

DISCUSSION

William H. Leak, D.D.S. (*New York City*): Dr. Barker has well presented his subject this evening; his paper is beautifully, clearly, and systematically written. He has set forth an undeniable argument for the care of children's teeth. What he says I for the most part agree with, and wish to express to him my deepest admiration for his devotion to this particular field of dentistry. I wish that more men were able to give their full time to the care of children; if not restricting their services to children, that they would at least do justice to the children who are brought to them.

The marvels of modern surgery have astonished the world. It is often even spectacular. By it thousands of lives have been saved. It has been regarded as the greatest achievement of medicine. Much less spectacular, however, is the work of the pediatrist. A study of the results which he has obtained in recent years will show a greater beneficial value to the world than those of the surgeon. The surgeons, like the dentists, are repair men. We hold a great respect for the surgeon. We hold a great respect for the reparative dentist. The beautiful and skilfully made restorations are not only praiseworthy but likewise of immense value to his patient. But for me, I hold a higher degree of gratitude to the pediatrician and likewise to the dentist who will also devote himself to the dental welfare of infants.

Many dentists have served patients over long terms of years, have seen their patients marry, know that they have children, but utterly fail to suggest that the children should be brought to them. Many children of such parents are taken to the dentist for the first time by sheer necessity and even then improper care, if any, is most frequently given the deciduous teeth. I fear that what too often pleases dentists is having persons come to them with several teeth missing and suitable conditions for the introduction of bridges. In such cases, somehow, we never fail to tell the patients of the inestimable value of having such work done. That is right and proper but it is our greater moral obligation and the opportunity of greater service to our patients to advise them to have the teeth of their children carefully attended to.

With the greatest consideration and respect for practitioners outside the city, I say, if it is true that some of the New York City men are the best; if they have the greatest abilities and their services are sought for that reason by persons residing outside the city—if people do not care to trust themselves to their town dentists but require the services of the New York man at far greater cost of time, convenience, etc.—then, they should also

require such services for those whom they love better than themselves, their children. It is my earnest belief that more specialized natural ability and careful technique is required in the care of the deciduous teeth than of the permanent teeth. The great city dentist, on the other hand, does not exert himself to impress upon his patients the necessity for accepting only the best service for the teeth of children. He refers his patients most earnestly to the eminent exodontists and periodontists, but the country dentist will do for the care of children's deciduous teeth.

While Dr. Barker's paper is entitled "Preventive dentistry: Period of deciduous dentition during transition to permanent dentition," he asks the question: "When is there a time that the body responds so quickly and easily to preventive measures as it does in childhood?" Thus he forces me to considerations outside the title of his paper, for I cannot believe that the most beneficial dental service can be rendered during the transitional period mentioned. The doctor's own examinations and examinations by many other dentists of the teeth of kindergarten and first-grade children reveal a very sad spectacle. Dental examinations made under my supervision of 742 pre-school-age children, children for the most part but five years of age, revealed that 36 per cent plus of these had teeth with non-vital pulps. Examinations I have personally made of large numbers of three-year-old and even four-year-old children, disclosed that not nearly so large a percentage have decayed teeth, nor are the individual cases nearly so severe as in children one or two years older. So I maintain that more can be done—and I have seen it done—for the teeth and the health of children by dental care at three to four years of age than can be done in the transitional period of the first to the second dentition. But I know an even more beneficial period than this. The fundamental and most important factor in the preservation of anything is that the object be composed in itself of the best materials. A sound and perfectly healthy babyhood is the fundamental factor in the good health of the child. Every tissue of that baby's body is subject to physiological and pathological changes save one tissue, the enamel of the teeth. The nutrition and health of the baby up to three years of age determines even the enamel of the second dentition. The enamel, the investing structure of all the normally exposed portions of the teeth, is altered only by chemical disintegration, erroneously called decay, or by wear or accident. The enamel of different children varies in hardness. Deficiencies in enamel formation are common results of malnutrition and disease. The production of good enamel, which goes with the establishment of health in the infant, is the first and most important factor in preventive dentistry.

Lack of proper mastication, due to improper foods and broken down teeth, is one of the great causes of poor assimilation, mal-nutrition, loss of weight, and anemia of children. It is certainly easy to suppose, and it is fair to presume, that children with broken-down teeth, unable to masticate properly, and with filthy mouths, are far more likely to become victims to contagious diseases.

Dr. Barker's illustrations (*figs. 1–4*) that show a material difference between two children, and which he attributes to dental conditions, are likely to prove misleading to some. It is an error to assume, and I am quite sure that Dr. Barker would not care to infer, that the dental conditions were the only governing factors in the difference between these two children.

About a year ago a dentist who is devoting his full time to preventive dentistry and who is in a position of great influence, visited our city and described his work to a small group of dentists. He cited a nutrition class of six children and the beneficial results to these children, following dental care. At that time I had nearly three hundred under-nourished children under my observation, to whom the best dental care was being given. No one can justly doubt the benefits which may come to a child, especially an under-nourished child, by giving it good dental care. However, it is wrong to draw conclusions from a small group. We may be accused of narrowness of vision if we attribute all the gains in health to dental corrections. With our dental care of a child certain other instructions are given, and the child's generally improved condition is usually the effect of several causes. The agents which usually contribute most to physical gain in children are change in environment, especially the taking of city children into the country; the season of the year (at the coming of summer you will find that most children gain in health and, with many of them, it is difficult to add more pounds after January); and, of course, good foods. I mention these not to minimize the dental factor but to show that we must recognize these influences, also, if we hope to receive the favorable support of people of careful judgment.

In his excellent paper Dr. Barker does not discuss non-vital deciduous teeth. I should like to have heard how he treats them. While all non-vital teeth may not be the cause of systemic disturbances, it has become an established fact that abscessed teeth are frequently the cause of infections of various organs of the body and may be the initial factor in the cause of death. Abscessed deciduous teeth may be just as detrimental to the child as abscessed permanent teeth are to adults.

If we are ever going to establish preventive dentistry, it will not come

by assuring patients that, if they allow their teeth to reach the worst state, the state of non-vital pulps, it will be an easy matter to save the teeth. One of the greatest measures for promoting preventive dentistry is to point out clearly to patients the serious consequences which may result from neglect—the cause of most non-vital teeth. When we begin to inform our patients that neglect means extraction, then our warnings will be more carefully heeded and more preventive dentistry will be practiced.

When one realizes how large is the number of little children suffering from cardiac infections, the majority of them with abscessed teeth, filthy mouths, and broken-down masticating surfaces—when frequently no other cause for the heart affliction can be presented—it is reasonable at least to assume that the abscessed teeth are the cause. The picture becomes distressing when we peep into our institutions and see the little that is being done for this type of child.

May I refer to another type of child—the tubercular child? For all such, and those predisposed to this disease, I believe the most desirable thing to do for them is to render their mouths free from abscesses, healthy and serviceable. The fundamental principles of treatment for tubercular persons are cleanliness and good nutrition. There is no better way to secure these than to provide mouth cleanliness and to see that the patients can masticate properly. Thousands of pages are printed about the sputum and its care but scarcely a word about the cavity, the mouth, from which the sputum comes. Cleanliness of the mouth will do much for the good of these patients and is the greatest factor in inhibiting germ action and preventing the spread of the disease.

One of the great reasons doubtless for the neglect of the deciduous teeth is the fact that normally they are shed at twelve years of age and replaced by the second set. But to consider them temporary and to treat them as such, is equal to considering life itself temporary and therefore failing to care for and to protect it.

All the purposes for which the second set of teeth are intended apply equally or with even greater force to the first set of teeth. All the diseases to which the second teeth are subject also affect the first set. All the serious ways by which the second teeth may affect the health of the adult, the first teeth likewise may affect the health of the child.

Because of the greater needs of the child for growth and development, and of its susceptibility to physical derangement and disease, I have no hesitancy in stating that the deciduous teeth are of greater value to the child than the permanent teeth are to the adult for like periods of time.

L. M. Waugh, D.D.S. (*New York City*): I desire to take just a minute to ask Dr. Barker to give us his opinion on the question of proper procedure when the pulp of the deciduous tooth is involved. He did not mention this in his paper, probably because he was told that in dividing the program with another essayist, his time would be limited.

To me, this problem is one of the most important in the care of deciduous teeth. Some twelve years ago it became our conviction that, when caries had so far encroached upon the pulp that its continued health and vitality were in question, the tooth should be extracted. We have followed this principle and with each succeeding year, the conviction has become more and more strengthened. There is an exception to every rule and in this case it is that when there is no follicle present for the permanent tooth and the deciduous one is to be retained, then extraction is contra-indicated, and the pulp cavity should be cleansed and filled as with a so-called permanent tooth. A deciduous tooth should in no case be extracted, unless there is evidence of the existence of a successor, without a radiogram having been made. There are many more missing follicles for permanent teeth than was formerly supposed.

When a deciduous tooth is extracted a considerable time before the permanent successor will erupt, as indicated by the radiogram, etc., it is *imperative* that a space retainer be placed to prevent the adjacent teeth from inclining toward each other, thereby tending to interfere with eruption later. Deciduous teeth are more prone to develop abscesses, after placement of deep-seated fillings and especially following pulp canal work, than are the permanent. We must realize that metastasis is just as possible, and as potent for bodily harm, in the child as in the adult. The sooner we apply this in our practice the better will be the service we render. Dr. Barker's paper has been interesting and instructive, and I shall be glad to hear his views.

Dr. Barker (*in conclusion*): Answering the last speaker first: Dr. Waugh spoke of a point which Dr. Leak also mentioned, in regard to the abscessed deciduous molar, or the pulpless deciduous molar, and he gave you the reason why I did not touch on it. I was limited as to time, and it is a phase of the subject which would require a paper in itself.

Regarding the pulpless deciduous molar, in the main I agree with Dr. Waugh; however, I do not believe in the indiscriminate extraction of these teeth merely because they are pulpless. It is advisable to get in touch with the physician to see what records he has of the child's health conditions. With a child six and a half to seven years old or perhaps

younger, with a normal healthy body and a high resistance, and everything to indicate that he would be able to carry that tooth without much trouble, we attempt in many cases to save it.

Dr. Waugh states that teeth should be extracted, provided space retainers can be placed. They can be placed in only a small percentage of these cases, as you all know. Those of you who do clinic work know that it cannot be done in that kind of service.

In private practice, we should be very particular about having those teeth remain when possible. Where there is a deciduous molar so loose that one side works up and down it should not be retained under any consideration, but should be extracted at once. Often, however, a succeeding tooth is missing under the second deciduous molars. You will often find a cavity that involves the pulp in a child of six years; but if you would extract simply because the pulp were involved, I believe you would do more damage eventually than if you allowed it to remain there properly treated and filled.

I wish to emphasize what Dr. Leak said about the dentists not having their patients bring in the children for examination. This comes under the head of education and should be done regularly. He also mentions the regard and respect for restorative dentistry. We all have that—we are very proud of what our men have done along the line of reparative and restorative dentistry, but we are trying to preach more preventive dentistry. Many times when I think of what the dental profession is doing, I recall the fable of the man who tried to empty the ocean with a tea cup. As fast as he dipped the water out just so fast did it run in and in the end he accomplished nothing. So it is with us. The more reparative work we do, the more there is to be done.

It is very desirable also to give dietary advice. At the Los Angeles meeting of the American Dental Association (1922) about three-quarters of the time was given to dietetic control of tooth formation.

The statement was made that in the cases I cited possibly the teeth were not the only factor in causing the child's general health condition. That is understood. In the majority of these cases, the condition of the teeth is a contributing cause; but, in the cases presented, the teeth were, I believe, the only cause. Bad tonsils and bad adenoids pull down a child's health; but certainly that fact does not relieve the dental profession of the responsibility to care for the deciduous teeth in those conditions.

PREVENTIVE ORTHODONTIA[1]

J. LOWE YOUNG, D.D.S.

Dr. Angle, in his Seventh Edition, defines orthodontia as follows: "Orthodontia is that science which has for its object the correction of mal-occlusion of the teeth." Preventive orthodontia we will define as that branch of dental science that has for its object the prevention of mal-occlusion of the teeth.

Normal occlusion implies that all the teeth in one jaw are occluding with the teeth in the opposing jaw, so as to furnish the largest area of grinding surface. The cusps, the inclined planes and the sulci into which they fit should combine to furnish the owner with the best masticating apparatus and should form dental arches which in regard to strength and durability cannot be otherwise equalled. The cusps of all the grinding teeth in such arches, interlocking with their antagonists, prevent these teeth from any variation in position either bucco-lingually or mesio-distally, provided that a harmonious pressure be exerted by the tongue, cheeks and lips. This regularity of the teeth in normal arches is also one of the chief factors in their resistance to decay, and to disease of the surrounding tissues, for the teeth, if they are properly formed, are in a position to be as nearly self-cleansing as possible. (*Figs. 1 and 2*).

In order to establish this desirable position of the permanent teeth, it is necessary that children be placed early in life in the hands of those qualified to judge when expansion of the deciduous dental arches is necessary. Very frequently the orthodontist is told by the parents that their dentist advised that nothing be done until all the deciduous teeth were lost; and that, when this period of development had been reached, and the dentist again consulted about the case, the parents were told that the child was too old to have the mal-occlusion corrected.

[1] Read at a meeting of the First District Dental Society of the State of New York, at the New York Academy of Medicine, on November 6, 1922.

The subject, then, for consideration is the best method of preventing the development of mal-occlusion. We all know that the deciduous dentition is far more liable to develop into a normal relation than is the permanent, but it must not be assumed that mal-occlusion is never found in the deciduous denture. In fact, all forms of mal-occlusion are found in the deciduous denture, and many of them should be treated prior to the eruption of any of the permanent teeth. (*Figs. 3, 4, 5, and 6*). Whenever the mal-occlusion in the deciduous denture is of such a nature as to interfere with its principal function, i.e., the mastication of food, interference is indicated, because we know that normal function is necessary in every tissue of the body to bring about normal growth and development. (*Figs. 7, 8, and 9*).

Before adjusting appliances on deciduous dentures, radiograms should be procured to ascertain if any of the permanent tooth germs are congenitally absent; and, when such is the case, it is often advisable to defer treatment until the eruption of the permanent teeth. (*Fig. 10*). The reason for this delay is due to the fact that, where appliances are adjusted on deciduous teeth to expand the dental arches, it has been observed that the resorption of their roots is accelerated; and this particularly applies to the second deciduous molars that are used as anchorage. It has also been observed that the second premolars are more frequently congenitally absent than any other tooth. We believe it good practice in such cases to retain the deciduous molars rather than to close the space or supply an artificial substitute.

From the deciduous denture, which is usually fully developed at the age of three, we have a period of three to five years before the permanent teeth begin to erupt. During this period the child is growing and the deciduous dental arches should grow also. In many children we find this growth does not take place. (*Figs. 11 and 12*). In such cases orthodontic treatment is advisable and should be so conducted as to cause as little annoyance to the child as possible.

The treatment indicated in all such cases is the expansion of the deciduous arches to provide for the developing permanent incisors, as these teeth are always wider than their predecessors and therefore must occupy more space. For this treatment, the removable lingual arch with auxiliary spring of light wire soldered well back toward the

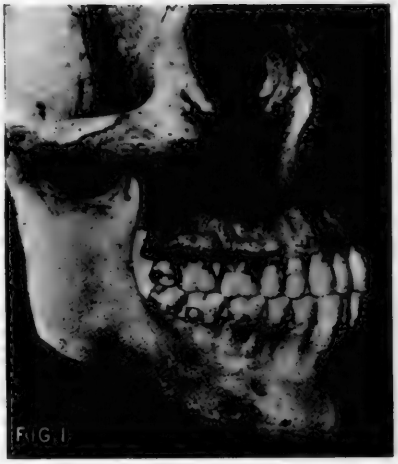

FIG. 1. NORMAL OCCLUSION OF AN ADULT

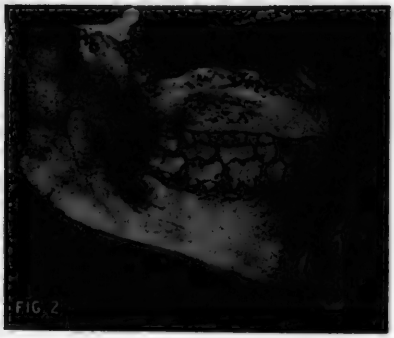

FIG. 2. LINGUAL VIEW OF THE NORMAL OCCLUSION OF AN ADULT

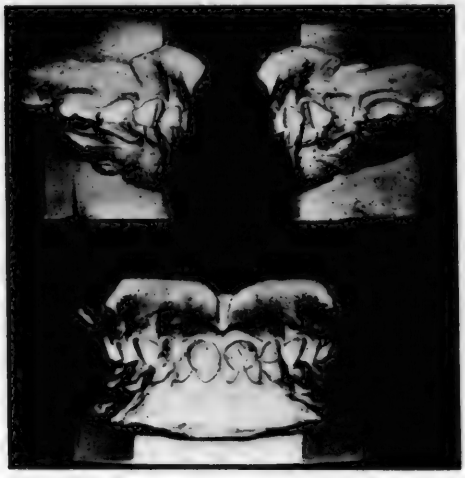

FIG. 3. NORMAL OCCLUSION OF DECIDUOUS TEETH AT 4½ YEARS OF AGE

second deciduous molar anchorage on each side is used, and so adjusted that these light springs exert a constant pressure to carry the deciduous molars and canines buccally. In addition to this, it is usually necessary to expand in the region of the anchor teeth; the second deciduous molars, and frequently the first permanent molars

FIG. 4. MADE FROM THREE SETS OF CASTS TAKEN AT THE AGES FIVE, SIX, AND EIGHT YEARS

FIG. 5. OCCLUSAL VIEW OF THE CASTS SHOWN IN FIG. 4

should be carried buccally as they erupt. The former is easily done by increasing the width of the removable lingual wire slightly, from time to time; but great care should be used so as not to rotate the anchor teeth and thus throw them out of occlusion, for, when this is done, more harm than good may result from such treatment. When

the first permanent molars erupt too far lingually, as they frequently do in such cases, it is a simple matter to solder a light piece of spring wire to the distal ends of the lingual arches and so adjust them that they will exert slight pressure on the erupting first permanent molars to carry them buccally. It is most important that these springs be

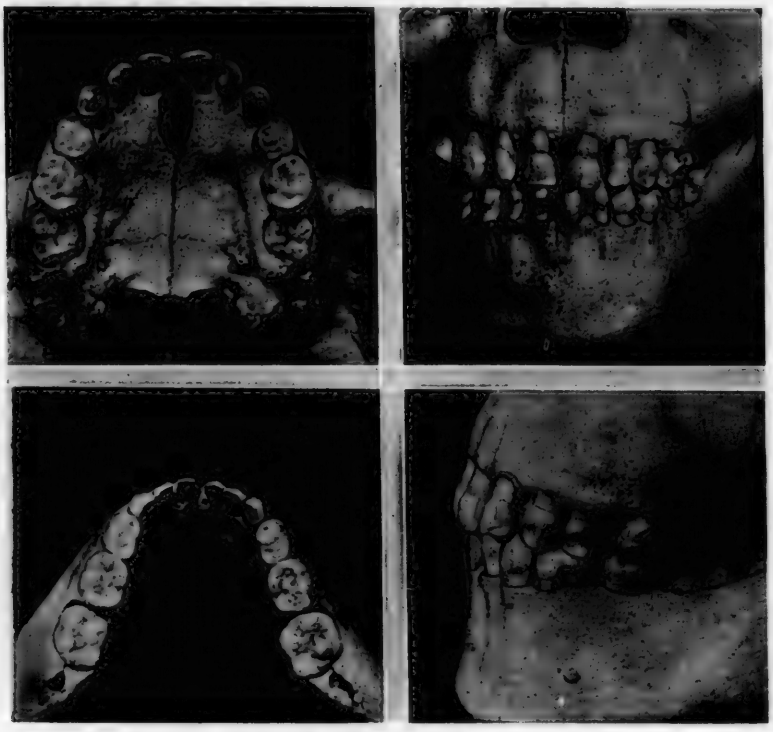

FIG. 6. A SKULL SHOWING BEAUTIFUL SPACING OF DECIDUOUS TEETH

so uniformly adjusted that the developing first permanent molars are guided into their proper positions.

When such treatment is properly conducted, in nine months to a year the dental arches will usually be large enough to accomodate all the permanent teeth that replace the deciduous ones; and, if treatment is started at the proper age, depending upon the development

of the child, the four permanent lower incisors and the upper centrals should be well developed. The appliances should be removed for several years and the case kept under observation. When the remaining deciduous teeth are lost, it may be necessary to adjust a new set of appliances to guide the remaining permanent teeth into their proper positions as they erupt, for it should ever be borne in mind that the

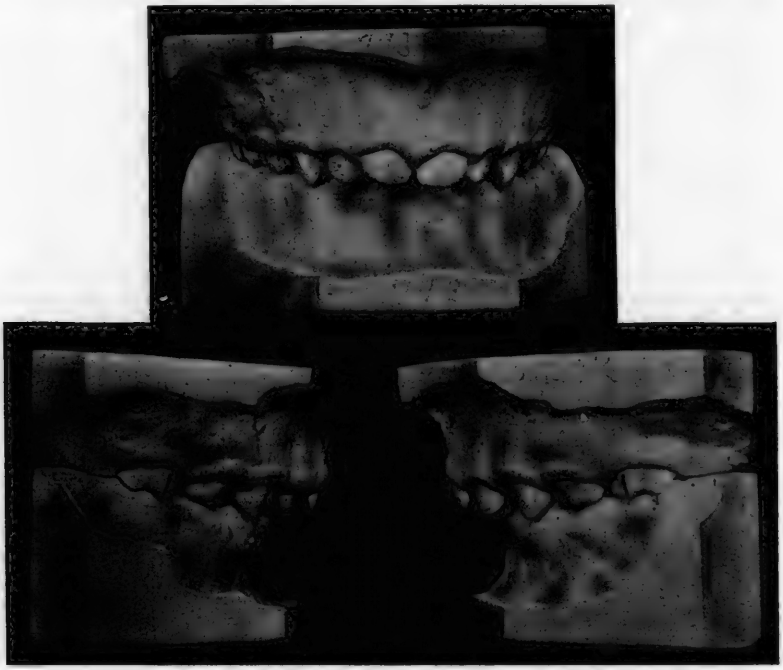

FIG. 7. CLASS II, DIV. 1: DECIDUOUS DENTITION

greatest service an orthodontist can render is to prevent rather than to correct mal-occlusion.

We know that the deciduous teeth have roots as large and as long in proportion to their size as have the permanent ones, and that these deciduous roots are surrounded by bone. In order that the permanent teeth may replace the deciduous ones, the roots of the deciduous teeth must be resorbed and the bone surrounding their roots must

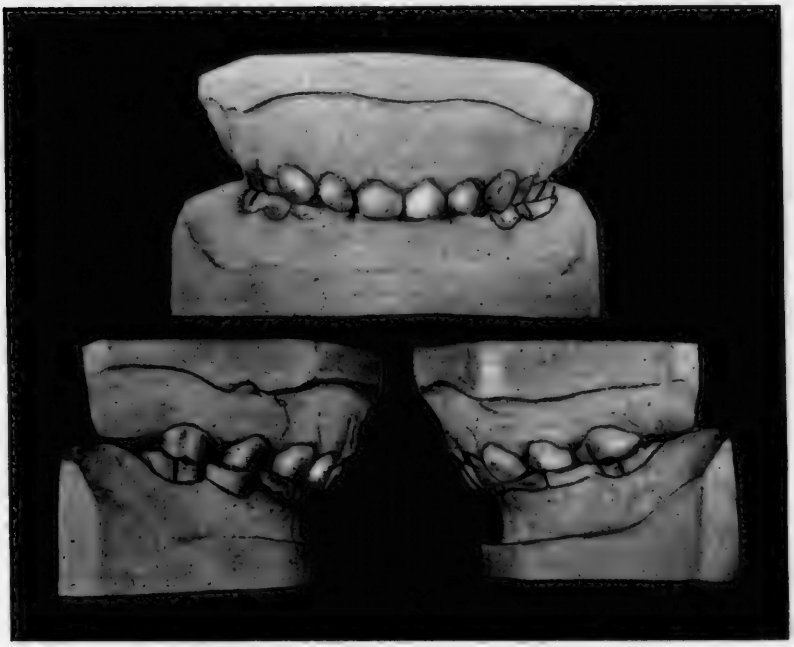

FIG. 8. CLASS II, DIV. 2: DECIDUOUS DENTITION

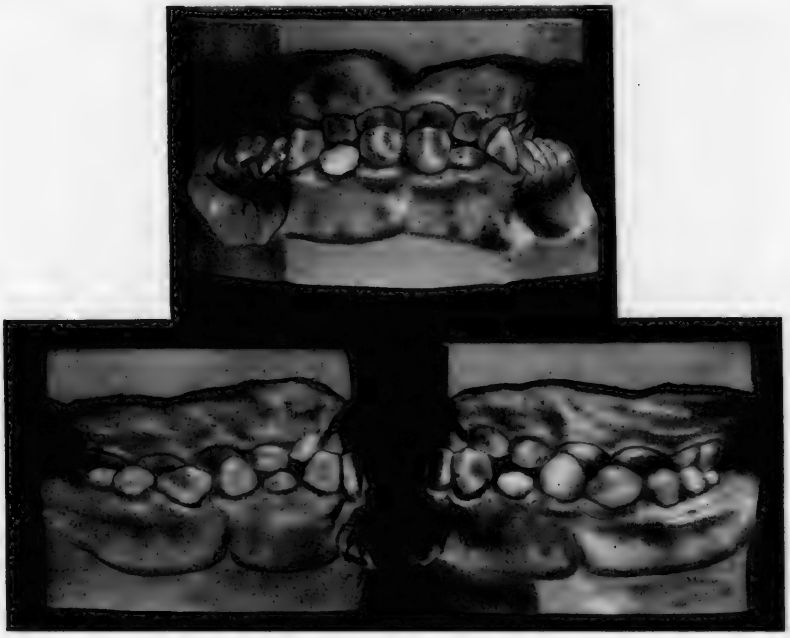

FIG. 9. CLASS III: DECIDUOUS DENTITION

FIG. 10. RADIOGRAMS, RIGHT AND LEFT, SHOWING ABSENCE OF MANDIBULAR SECOND PRE-MOLARS

FIG. 11. OCCLUSAL AND FRONT VIEW OF CASTS, SHOWING THE SIZE OF THE DENTAL ARCH AT FIVE AND ONE-HALF AND THIRTEEN YEARS OF AGE

FIG. 12. OCCLUSAL AND FRONT VIEW OF CASTS, SHOWING THE SIZE OF THE DENTAL ARCH AT FOUR AND ONE-HALF AND SIXTEEN YEARS OF AGE

also be largely resorbed so that the permanent teeth may erupt. As the permanent teeth develop new bone must grow around them. (*Fig. 13.*)

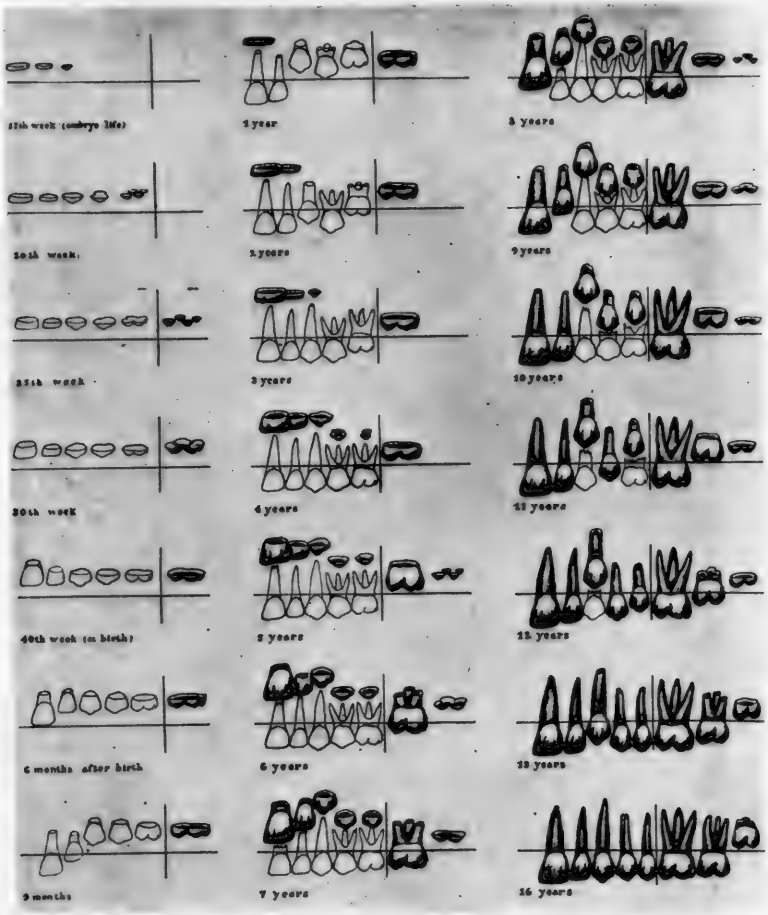

FIG. 13. DEVELOPMENT, ERUPTION AND ABSORPTION OF THE PERMANENT TEETH (BRADY)

In a very large percentage of children where there has been approximal decay of the deciduous molars, they have either been neglected

FIG. 14. AN EXTREME CASE OF MALOCCLUSION

FIG. 15. OCCLUSAL VIEW OF SAME

FIG. 16. THE SAME CASE (FIG. 14) FIFTEEN MONTHS LATER

FIG. 17. OCCLUSAL VIEW OF THE SAME CASE (FIG. 15), FIFTEEN MONTHS LATER

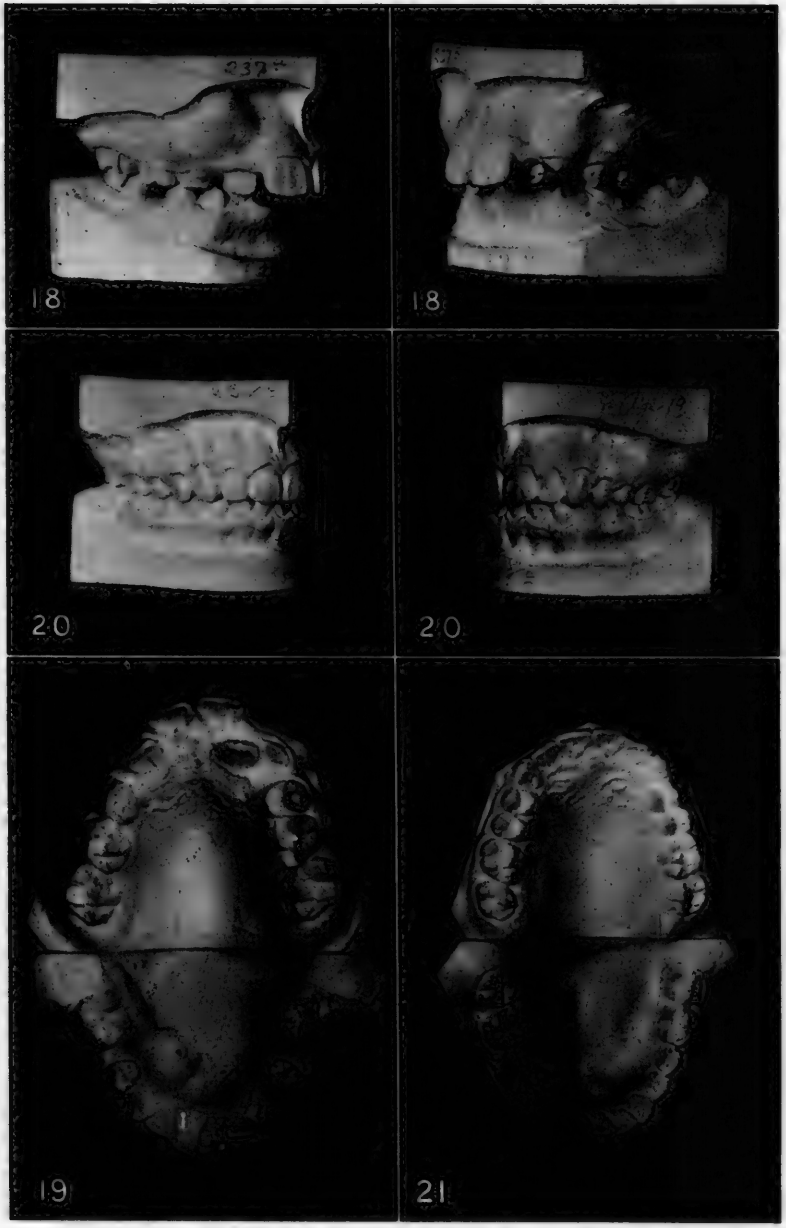

FIG. 18. TWO SIDE VIEWS OF AN EXTREME CASE

FIG. 19. OCCLUSAL VIEW (FIG. 18)

FIG. 20. TWO SIDE VIEWS AFTER TREATMENT (FIG. 18)

FIG. 21. OCCLUSAL VIEW AFTER TREATMENT (FIG. 19)

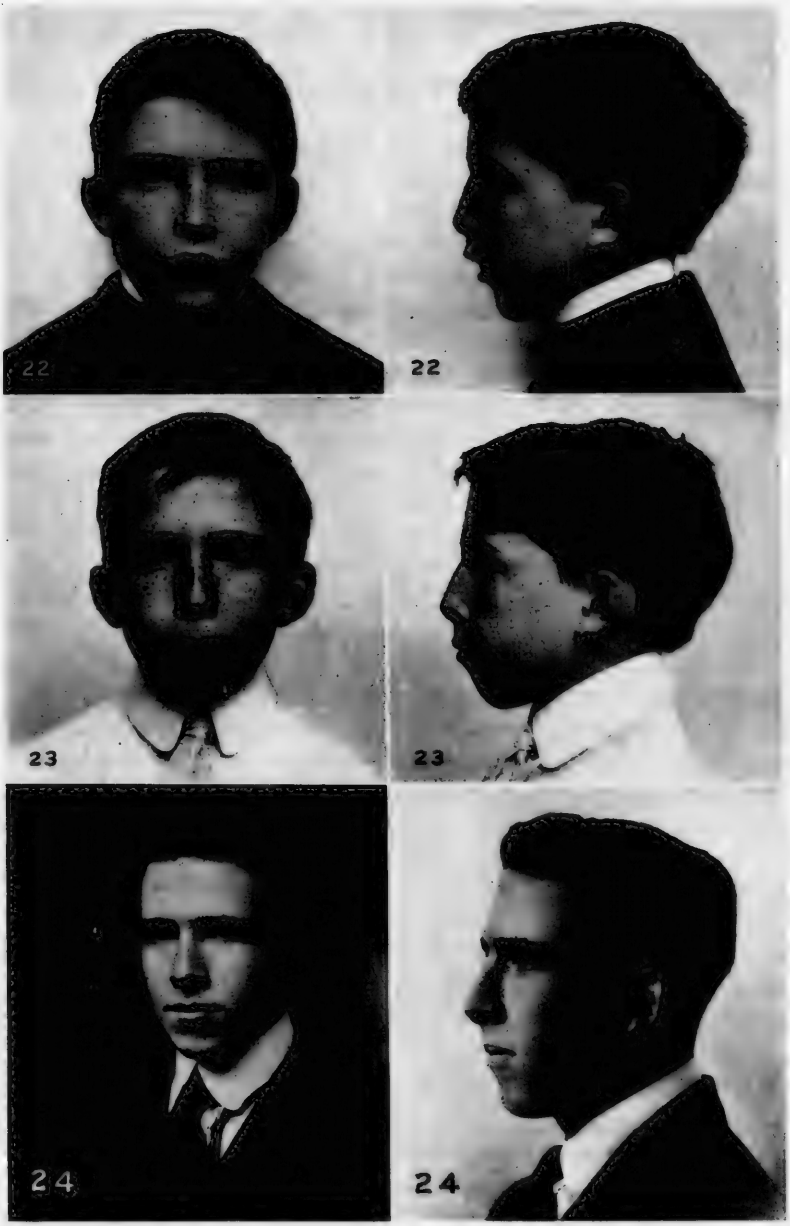

FIG. 22. FRONT AND SIDE VIEW OF THE FACE BEFORE TREATMENT

FIG. 23. FRONT AND SIDE VIEW OF THE FACE AFTER TREATMENT (FIG. 22), ONE YEAR LATER

FIG. 24. FRONT AND SIDE VIEW OF THE FACE AFTER TREATMENT (FIG. 22), TEN YEARS LATER. DID HE GROW UP TO HIS TEETH?

or so filled that the mesial distal diameter of these teeth has been reduced; and this always results in a forward movement of the permanent molars when they erupt, and a crowding in the premolar and canine regions. The premature loss of these deciduous teeth is likewise followed by a drifting forward of the first permanent molars and frequently results in a shrinking of the overlying tissues to such an extent as greatly to retard the eruption of their permanent successors. It is the duty of the dentist so to fill these teeth that their normal mesio-distal diameters are restored; and where deciduous molars are lost, the spaces should be maintained by some simple appliance. Many cases that come to the orthodontist would never have required his attention had this procedure been followed.

It is quite another matter where all the permanent teeth are allowed to erupt in mal-occlusion before the beginning of treatment. Such a case is shown in *figs. 14, 15, 16, and 17*. Another pronounced case, with the result of treatment, is shown in *figs. 18 to 24*, inclusive. In the treatment of such cases it is obvious that bone must be developed outside the bone on the labial and buccal surfaces of the teeth to be moved, and that the bone intervening between the present position and the new position the teeth are to occupy must be resorbed; and also that there must be a building up of bone in the space now occupied by the roots of the teeth to be moved.

The appliances to be used on the permanent teeth depend on the case in hand. In cases showing pronounced lack of development of the dental arches and surrounding structures, a modification of the Angle Pin and Tube Appliance has proven in many cases most advantageous. When the bands for such an appliance are properly constructed, it is possible to move the teeth bodily and as desired by the operator, if he learns how to manipulate it properly. The disadvantages of this appliance, as given to the profession, are the following:

(*a*) The three-piece arch was unstable and, owing to the play in the joint where the middle section entered the end sections, it was found difficult to carry the molar teeth buccally.

(*b*) The accuracy of fit of the pins in the tubes made it extremely difficult to construct.

(*c*) The inability to rotate teeth, except the upper centrals, due to the shape of the tubes and pins.

All these disadvantages are overcome by using short elliptical tubes soldered to the molar bands parallel to the long axis of the tooth, thus eliminating the three-piece arch, by replacing the round labial tubes with small half-round tubes, and by using half-round material for pins at least 0.002 of an inch smaller than the bore of such tubes.

It is frequently claimed that orthodontic appliances are responsible for dental caries, but it must ever be borne in mind that the great majority of instances of dental caries begin during the age when children should be under treatment by the orthodontist. It must also be remembered that some children are more liable to dental caries than others. Where appliances are properly constructed and the child properly instructed in home prophylaxis, the danger of decay is no greater than in the average child that does not wear appliances.

For four years I have urged the use of Prophylactic Tooth Powder for my patients; and, while many children are averse to the use of a tooth powder, I have found that wherever the children have consistently used this powder for their teeth and appliances, their mouths are much cleaner than when any other dentifrice has been used. Many cases have been under orthodontic treatment for several years without a single cavity of decay occurring in any of the teeth and I attribute this to the repeated advice to the parent and child of the importance of home prophylaxis.

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DISCUSSION

Dr. H. E. Kelsey, D.D.S. (*Baltimore, Md.*): It has become an axiom that prevention is better than cure, and this surely applies as forcefully to orthodontia as to any other branch of dental science. But hitherto it must be admitted that the orthodontist has been so busy with necessary corrections of mal-development, that he has not been able to give to the subject of preventive orthodontia the study and attention which its great importance deserves. Any branch of the healing art which could, by the teaching of preventive methods, eliminate the demand for its services, would leave a monument to its memory which could not be equalled by any successes of treatment.

In his usual brief and concise way, Dr. Young has touched upon the vital

points in his subject and has furnished many texts which he and others may elaborate indefinitely in the future. He says, "the subject then for consideration is the best method of preventing malocclusion," by which he means, as he explains later, the adoption of such a procedure as will, if carried out, result in the development of a normally efficient masticating organ.

I am highly in accord with all he says in regard to methods and time of treatment instituted to overcome, through artificial stimulation by means of appliances, subnormal or abnormal development of the child denture. I have recently had a case which strikingly illustrates and supports his statement, that many cases of malocclusion which are treated by orthodontists need not have occurred had intelligent prevention been resorted to at the right time. In this case, of an otherwise perfect denture, a temporary second molar was retained after all other deciduous teeth had been lost, which should have been ample cause for suspicion that its permanent successor was either missing or malposed. This tooth was extracted, however, without recourse to the x-ray; and though fortunately the permanent premolar was present (although deeply placed in the jaw), so that eventually it will come into useful occlusion, no measures were taken to prevent the tipping of the teeth, anterior and posterior, into the space. This is just what occurred, gradually making the eruption of the permanent tooth impossible and otherwise impairing the occlusion of that side. Several months afterward an x-ray was taken, and the patient was then brought to me for treatment, which must consist, of course, in replacing those teeth in their normal positions and maintaining them until the premolar has erupted. The insertion of a little splint from molar to first bicuspid would have been a simple means for avoiding all orthodontic treatment, unless the tooth had erupted in a rotated position, the correction of which, however, would have been very simple. It should further be emphasized that there should be no extraction under such circumstances without first having a satisfactory radiogram made. Had the permanent successor been missing, a still worse malocclusion would have resulted or an artificial substitute would have had to be inserted; and I fully agree with Dr. Young that a temporary tooth is always the best substitute for a missing permanent one, providing it rises to the occlusal plane of the permanent teeth, as it does in the majority of cases, though not always. I have in mind the case of a married women more than forty years of age, who has both lower temporary molars substituting for second premolars and doing excellent service. It is true that the larger size has caused some crowding in the lower incisor region, but her denture is far better in appearance and efficiency than if those teeth

had been removed, no matter what after-course of treatment might have been adopted.

I am in complete accord with the author's statement that the temporary denture is far less liable to malocclusion than the permanent one, and I believe this is due to the fact that nature begins the building of the temporary denture before birth and carries it on after birth, with less dependence upon function than is the case with the development of the permanent denture. The temporary denture, in other words, is prepared for function as are most of the other organs, the health and further development of which, however, are henceforth dependent in a large measure upon natural use, which is function. The layman notes none of the ill effects of lack of use of the temporary denture until its loss and the crowding of the larger permanent teeth in the undeveloped arch brings it to his attention; and he views with consternation and amazement a condition which the orthodontist would have long foreseen, had the case come under his observation at the age of from four to six years.

It is this phase of educational prevention which appeals most strongly to me, and which should become the slogan of a campaign that should be carried to the laity throughout the land. Could we once make them understand as we understand, that normal development can take place only when nutrition and function are approximately normal, we should have done more toward reducing the high percentage of malocclusions than in all other ways combined, making both preventive and corrective treatment to a great extent unnecessary. In this connection I desire to quote from a paper, presented by the writer before the Pennsylvania State Dental Society, entitled, "The normal function of the child denture in its relation to development of the jaws and other facial bones and the preservation of the teeth."

"While a child at birth is a helpless little mass of humanity so far as locomotion is concerned, it has nevertheless certain well developed muscles which are associated with the function of nutrition, and which enable it to extract its natural food from the breast with as much tireless energy as it will ever exhibit later in life in any other capacity. And during this period of its life, it never suffers lack of development in the oral region if fed in the natural way.

"By the time then, that a child has reached an age when it exhibits an instinctive tendency to begin to take food other than milk and in a manner other than by sucking, it should have become manifest to its parents that nature's methods should be continued in its feeding, and that, as teeth have been provided, the child should be allowed and encouraged to use them.

"Among most mammals—and there is no reason why the human race should be an exception—there is a period during which the young take both milk and solid food, their

size gradually making the supply of milk no longer adequate for their needs, even did not nature, after a certain time, begin to diminish the supply of milk, preparatory to casting the new creature upon its own resources. And it is during this period that its instinct to reduce solid food by long mastication and mixing with saliva to almost the consistence of the liquid milk to which it has been accustomed, is strengthened into a habit, and thus the inclination to masticate properly is acquired and fixed so that it will not be lost later. It is the writer's conviction, supported by such investigation as he has so far made, that if the habit is not formed at this time, it will never, or only in rare instances, be acquired later in life by a mere exercise of the will through the individual's knowledge that it is good for him."

If we have information then, which, if possessed by the laity, would enable them to avoid even a part of the malocclusion which is developing among children, it is our duty to give it to them.

It is my conviction that as a race civilized man has not undergone any great physical degeneration and that the normally born children of healthy civilized parents are as capable of normal robust development of all their organs, including the denture, as are the children of primitive parents, providing they are reared under the same natural conditions.

I hope I have not digressed too far from the subject matter of the paper. If so, my excuse is that I agree so completely with the technical procedure so clearly described by the essayist that much elaboration of that portion of his paper would be superfluous.

Dr. Young (in conclusion): I want to thank the members of the Society for their attention, and Dr. Kelsey for his kind consideration of my paper. I have nothing further to say.